Softrock
SDR receiver
Ver 9.0

RX Lite + USB Xtall V9.0 Kit - Home Page

(Last modification: 2 Jan 2010

Home BOM Power Supply USB Control Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPF(s); Programmable BPFs; External Connections Comments Revisions WB5RVZ Home

Introduction

This is the home page for the Detailed Builder's Notes for the Softrock "Lite + USB Xtall" V9.0 Software Defined Radio receiver, the latest in a series of SDR kits offered by Tony Parks KB9YIG.

The intent in providing these detailed instructions is to help the less experienced builder through what might otherwise be a daunting task. The instructions provide a stage-by-stage build process, allowing the builder to build a single stage and then test it ("sanity check") before moving on to the next stage.

Much of the documentation was initially developed entirely from the schematic and from the earlier V8.3/8.4 documentation. Over time, the author may post changes to the affected web pages, as necessary. You should check periodically to see if there have been any revisions, especially in the area of Stage-end tests. If your browser is caching pages, you may need to hit the "refresh" key (F5 on IE and Firefox) to get the latest version of the page.

These notes can be downloaded as a PDF file here. Thanks to Craig AB9IV.

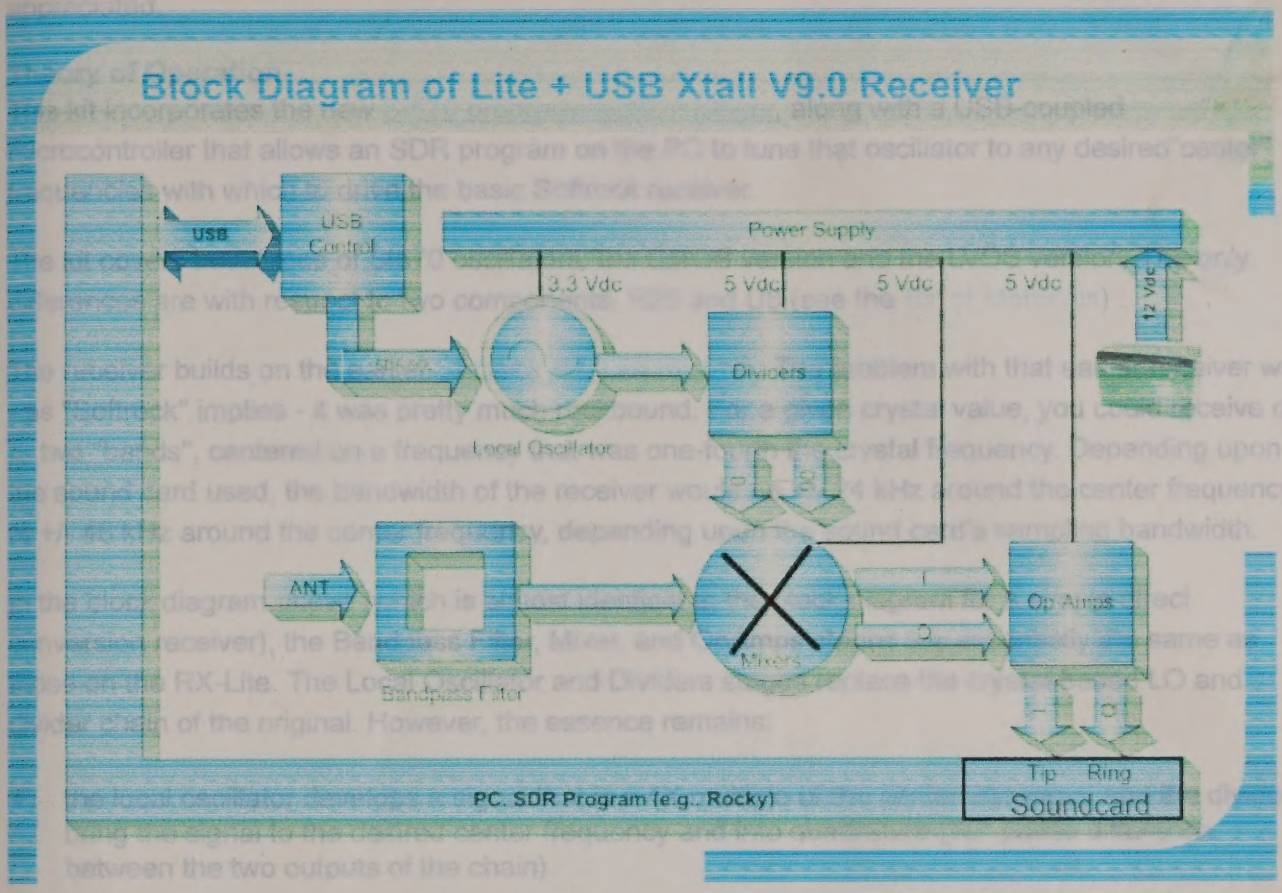
Ordering Information

Prices and availability of the kit and its options are found at the Softrock Ordering Website.

Build Stages and Schematic

Construction Stages and Theory of Operation

(Click on a stage to view its detailed builders' notes)



Each stage will have a subset of the overall schematic diagram. Each sub-schematic is annotaded with clickable text to show "from/to" stages. The user can click on the text and link to the appropriate stage.

The schematics are annotated with red dots to designate the resistors' hairpin leads (or for a flat-mounted resistor, the left-hand or top lead).

To view the schematic diagram for the entire receiver, see Overall Schematic Diagram from Tony's original documentation.

For the more experienced builder, each stage has a "Summary Build Steps" section which outlines the sequencing of tasks within the stage and provides a link to the testing stage (bypassing the detailed installation notes).

For the most experienced builder, see the "Terse" builder's notes below.

For the rest os us, detail construction steps and tests are provided in each stage and will be highlighted by special Icons:

A step in the detailed build section

A test operation in the Testing section

An optional test using an oscilloscope.

Any comments or corrections should be directed to the author, Robby WB5RVZ, and would be most appreciated.

Theory of Operation

This kit incorporates the new Si570 programmable oscillator, along with a USB-coupled microcontroller that allows an SDR program on the PC to tune that oscillator to any desired"center" frequencies with which to drive the basic Softrock receiver.

The kit covers both types of SI570 oscillators: the CMOS version and the LVDS version. The only differences are with respect to two components, R25 and U8 (see the Bill of Materials) .

The receiver builds on the earlier Softrock RX-Lite receiver. The problem with that earlier receiver was - as "Softrock" implies - it was pretty much rockbound. For a given crystal value, you could receive one or two "bands", centered on a frequency that was one-fourth the crystal frequency. Depending upon the sound card used, the bandwidth of the receiver would be +/- 24 kHz around the center frequency or +/- 48 kHz around the center frequency, depending upon the sound card's sampling bandwidth.

In the block diagram above (which is almost identical to the block diagram for a simple direct conversion receiver), the Bandpass Filter, Mixer, and OpAmps stages are essentially the same as those on the RX-Lite. The Local Oscillator and Dividers stages replace the crystal-based LO and divider chain of the original. However, the essence remains:

- the local oscillator develops a signal that is a 4X multiple of the center frequency and the dividers bring the signal to the desired center frequency and into quadrature (90° phase difference between the two outputs of the chain).
- These 2 signals are fed to the Mixer stage, which down-converts the "chunk" of RF that is in the passband of the bandpass filters into 2 "chunks" of audio representing the difference between the incoming RF and the LO quadrature signals.
- These 2 AF signals are identical, and 90° out of phase with each other. They are amplified in the Op-Amps stage and fed into the PC's sound card to be digitized and processed.
- An essential part of that digital signal processing is using the quadrature streams to tease out the signals that are above the center frequency from those that are below the center ferequency, yielding a spectrum centered on the center frequency.

The real advance here is the use of a programmable oscillator (SI570) in the local oscillator circuit and a USB control circuit to program the Si570. (The USB control circuit also provides PTT switching outputs and keyer/stgraight key inputs for the SDR software running on the PC, but these are not needed for RX only operation). This setup allows the user to select any desired center frequency. This is a major advance over the Version 8.3 receiver, which only permitted switch selection of up to 16 pre-programmed center frequencies and leaves the rockbound RX Lite in the dust!

The other advance is changing the design of the bandpass filters to allow for removable filter boards

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See, also, the [illegible] discussion

Bill of Materials

Each stage of construction will be preceded by a detailed bill of the materials for that stage, ordered in the sequence in which the different components are to be installed.

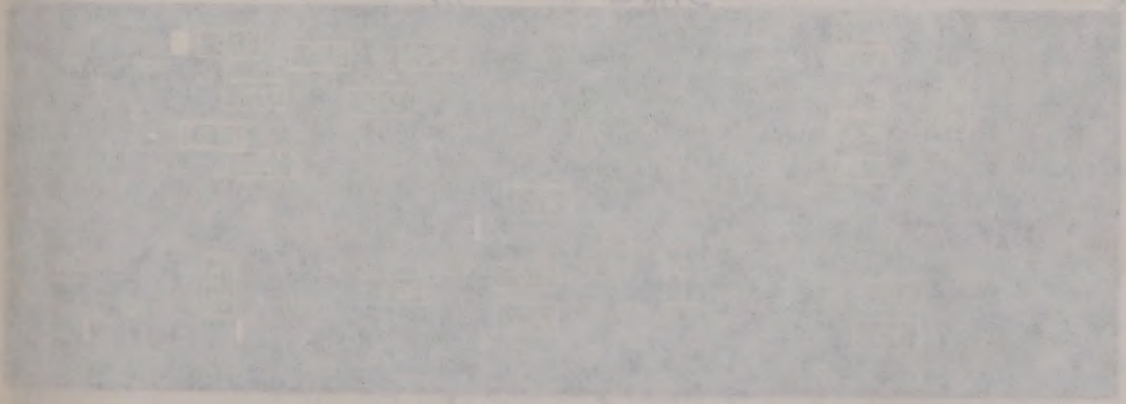
For reference and inventorying purposes, the overall bill of materials is provided in a [illegible]

Terse Build Notes for the "Experts"

Tony's original build instructions for the expedited, "non-staged" approach are provided here for reference. If you plan to follow the staged construction approach outlined in this and subsequent pages, do not attempt to follow the steps listed below

Board Topside

Board Bottomside TP V1 Ring is white (Sticky Cable Strained)



Board Bottomside (with reversed [illegible] silkscreen overlaid)

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See, also, the Detailed Theory of Operation discussion.

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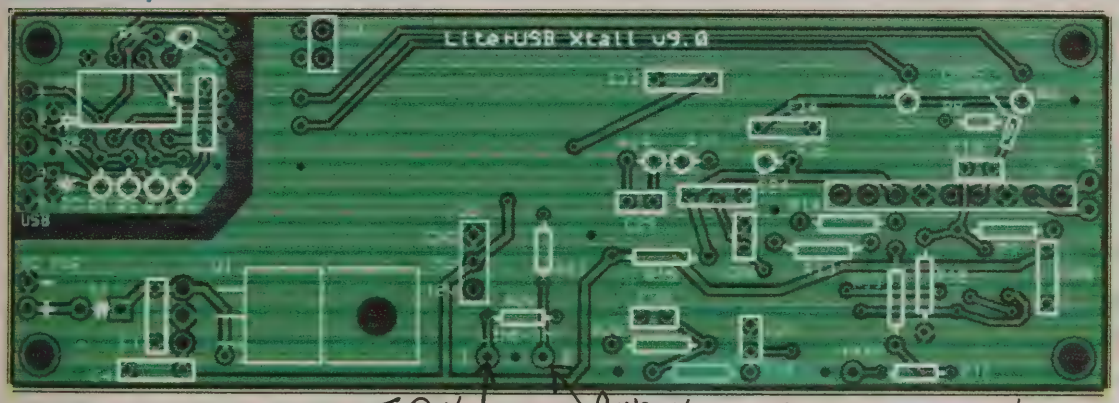
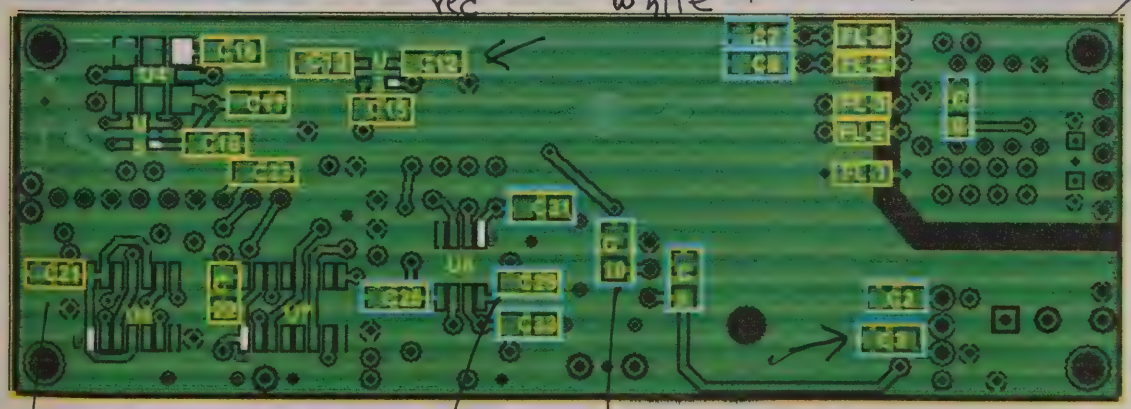
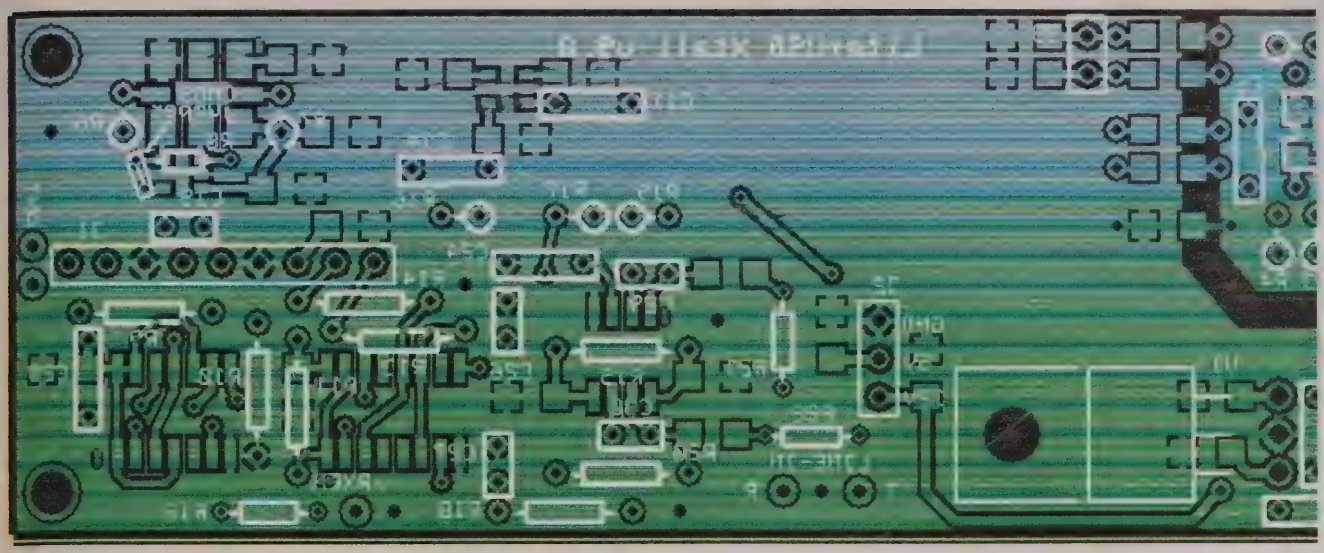


Tip is red Ring is white (stereo cable standard)

Board Bottomside



Board Bottomside (with reversed topside silkscreen overlaid)



Tasks for "Stuff-the-Board-and-Then-Test" approach (said Tom tersely)

- Install all SMT Capacitors to bottom of board (see graphic, above) , except for those around U3 (C12, C13m abd C15) and (if U5 is used) C18.
- Install Five pin SMT 3.3V Voltage Regulator, U3, to bottom of board.
  Make sure U3 leads are well-centered on their pads, then tack the IC in place by careful soldering of one lead. Apply heat to pin to reposition U3 and, when properly positioned, carefully solder the other leads.
  Use solder wick to remove excess solder or solder bridges between pins.
- If using LVDS version of Si570, install U5, Fin1002, on bottom of board in same careful fashion as U3. U5 is NOT installed if the Si570 is the CMOS version.
- Install remaining SMT capacitors (C12, C13, and C15)
- Install U4, Si570, on bottom of board with careful soldering as with U3. Note that there are 8 "pins" to be soldered.
- Install remaining SOIC SMT ICs to bottom of board (if an IC in the kit fits a location, it is the correct IC for that location).
- Mount 5V Voltage regulator U1, LM7805, to top of board with a 4-40 machine screw, #4 start lockwasher, and hex nut, attaching the tab of U1 to the board.
- Mount the 2 and 3 pin sockets, J3 and J2, in the J3 and J2 locations.
- Mount 9-pin socket J1 in its location.
- Install resistors R1-R22 on top of the board, with R1-R7, R16-R17, and R19mounted "hairpin" style. All other resistors are mounted flat.
  Note: R8 is NOT installed if the Si570 is the CMOS version
- Install capacitors to the top of the board in the locations shown on the silkscreen.
- Install the socket for U3 on top of board.
- Diodes D1-D3 on top of board in hairpin fashion with diode body above each round

pad.

- Connect a shorting wire in the CMOS jumper location if the Si570 is the CMOS version.
- Connect a shorting wire between the /RXEN hole and the ground hole immediately to its left.
- Build desired band pass filter board(s) and mount on J1 such that the 3 header pins go to J1's left-most 3 pin sockets.

Detailed Build Notes

If you prefer to take the more methodical, "build a little, test a little, ..." staged approach to building this kit, this web site is for you. In the pages that follow this home page, you will find the notes for the construction and testing of each of the stages of the build.

The build will go through the following stages

Each stage will Have the same basic sections:

- Introduction and theory of operation
- Schematic - a subset of the overall schematic diagram
- Bill of Materials - a build sequence ordered set of the items to be installed in the stage
- Summary Build Instructions - a summary of the steps in the stage
- Detailed Build Instructions - the step-by-step, detailed tasks of the build
- Testing - one or more tests that can be conducted to validate the built stage

Testing

Most of the tests specified in these pages can be accomplished with a moderately priced digital multimeter. Some tests using more sophisticated tools may be specified, but are not really essential to successfully building and testing this radio.

Measurements specified in the tests must be considered approximate and the tester should expect a

fairly wide (+/- 1--20%) range of values around the specified values.

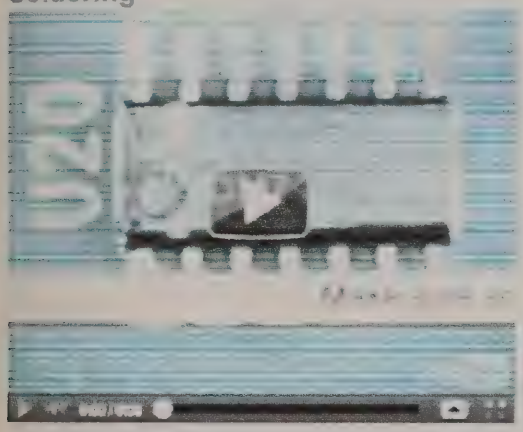
Tests will be identified by the following icons:

An optional test that may require HF transceiver to transmit into a dummy or

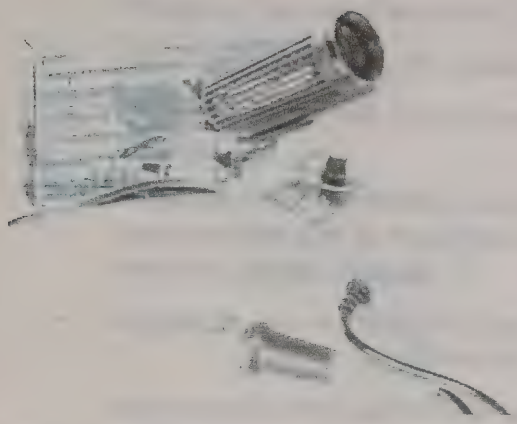
Background Info

Tools

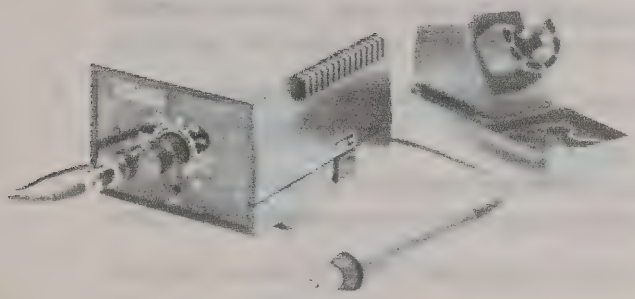
Soldering



- Read the at the Sparkfun site. It is a very good read and it speaks great truths. Then take the time to watch the .
- For more general "how-tos" on soldering, Craig KB5UEJ highly recommends the videos at .
- "Splashover": Be careful when soldering SMT components to the bottom of the board. In some cases There are holes through which topside component leads must pass and which can easily get clogged with "solder splashover", where the hole is very close to an SMT pad.
- Solder Stations. Don't skimp here. Soldering deficiencies account for 80 percent of the problems uncovered in troubleshooting. It is preferable to have an ESD-safe station, with a grounded tip. A couple of good stations that are relatively inexpensive are:



- Velleman (approx $20 at Frys)



- Harbor Freight

Electro Static Discharge (ESD) Protection

- Whenever you see the symbol on the left, this means to take ESD precautions:
- Avoid carpets in cool, dry areas.
- Leave PC cards and memory modules in their anti-static packaging until ready to be installed.
- Dissipate static electricity before handling any system components (PC cards, memory modules) by touching a grounded metal object, such as the system unit unpainted metal chassis.
- If possible, use antistatic devices, such as [illegible] (see [illegible] for $25 or the [illegible] for $15)).
- Always hold a PC card or memory module by its edges. Avoid touching the contacts and components on the component.
- Before removing chips from their insulator, put on the wrist strap connected to the ESD mat. All work with CMOS chips should be done with the wrist strap on.
- As an added precaution before first touching a chip, you should touch a finger to a grounded metal surface.
- If using a DMM, its outside should be in contact with the ground of the ESD mat, and both leads shorted to this ground before use.
- See the review of ESD Precautions at this .

Work Area

- You will need a well-lit work area and a minimum of 3X magnification (the author uses a [illegible] with a 3X lens. This is suplemented by a [illegible] - with light - for close-in inspection of solder joints and SMT installation.
- You should use a cookie sheet or baking pan (with four sides raised approximately a half an inch) for your actual work space. It is highly recommended for building on top of in order to catch stray parts, especially the tiny SMT chips which, once they are launched by an errant tweezer squeeze, are nigh on impossible to find if they are not caught on the cookie sheet.

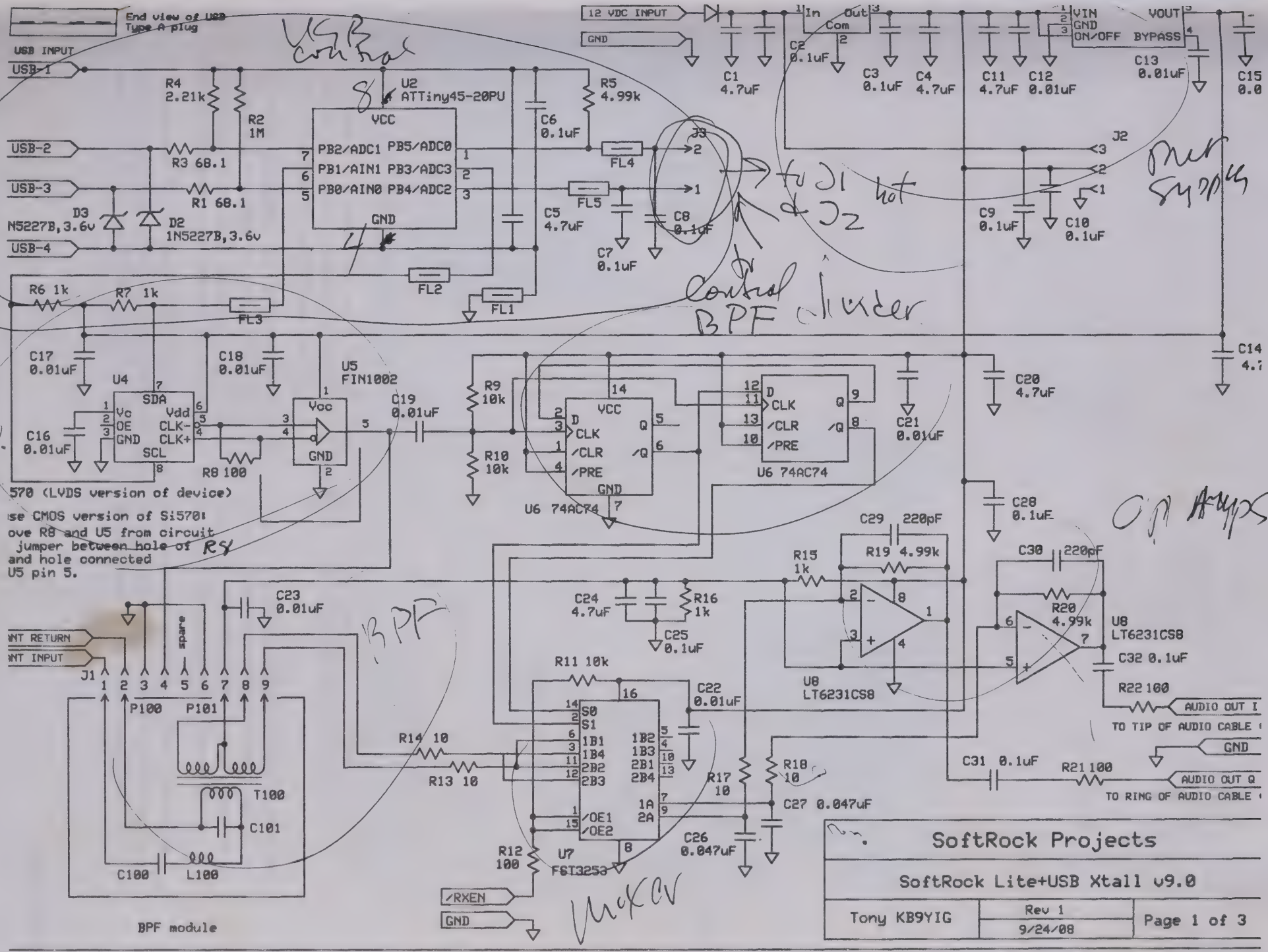
Misc Tools

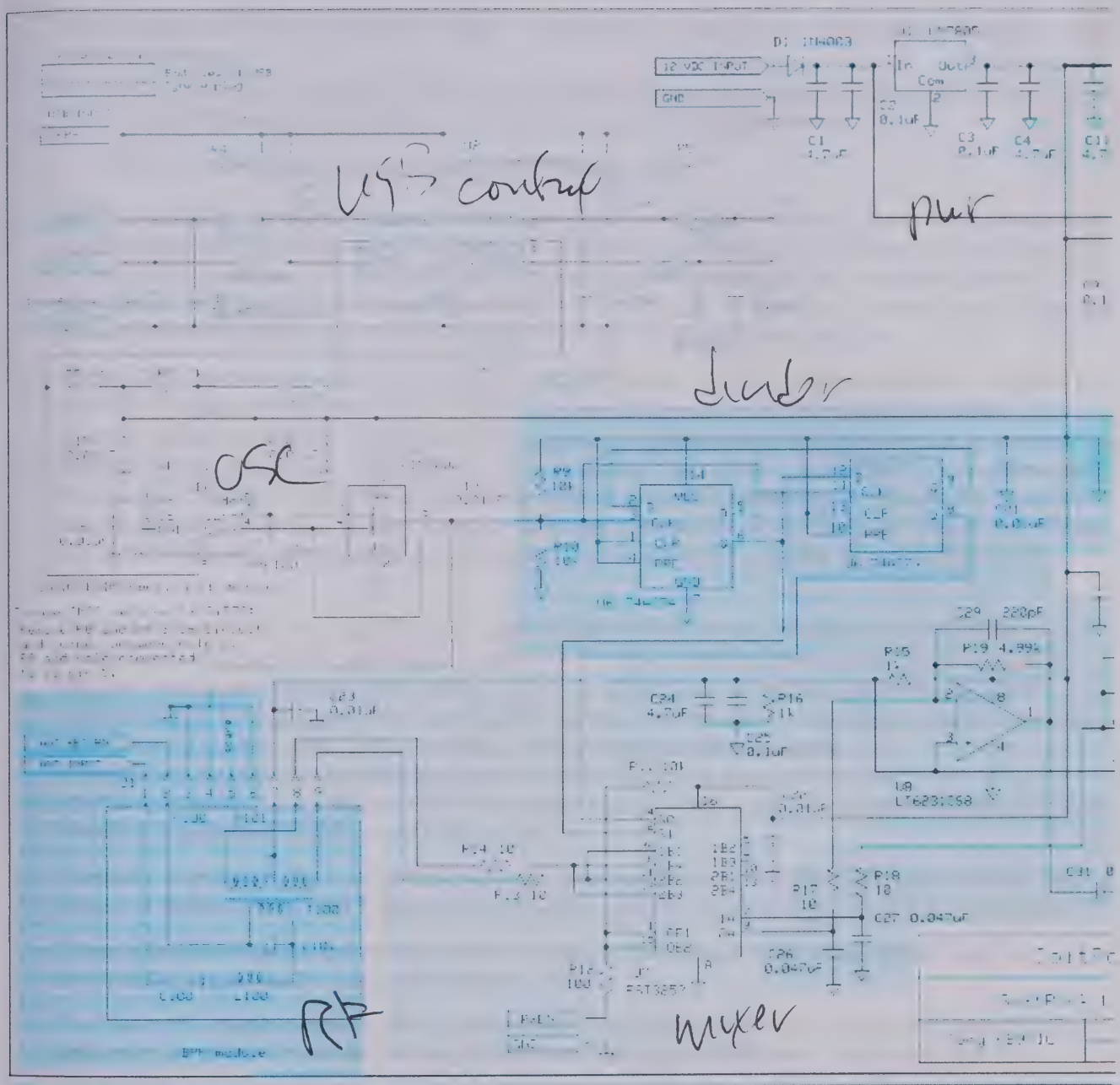
- It is most important to solidly clamp the PCB in a holder when soldering. A "third-hand" (e.g., [illegible] or the [illegible]) can hold your board while soldering. In a pinch, you can get by with a simple [illegible]. Jan G0BBL suggests "A very cheap way is to screw a Large Document Clip to a woodblock which will clamp the the side of a PCB."
-
- [illegible] (bent tip is preferable).
- Diagonal side cutters.
- Small, rounded jaw needle-nose pliers.
- Set of jewelers' screwdrivers
- An Exacto knife.
- Fine-grit emery paper.

V9.0 Main Schematic

Schematic

Below is the main schematic of the Lite + USB Xtall V9.0 SDR. The schematic has been partitioned into separate stages, each of which is covered in a separate page of build instructions in this web site. You can click on each shaded area and view the corresponding stage builders' notes.


End view of USB Type A plug
USB INPUT
USB-1
USB-2
USB-3
USB-4
R4 2.21k
R2 1M
R3 68.1
R1 68.1
D3 N5227B,3.6v
D2 1N5227B,3.6v
U2 ATTiny45-20PU
VCC
PB2/ADC1 PB5/ADC0
PB1/AIN1 PB3/ADC3
PB0/AIN0 PB4/ADC2
GND
R5 4.99k
C6 0.1uF
C5 4.7uF
C7 0.1uF
C8 0.1uF
FL1
FL2
FL3
FL4
FL5
J3
J2
J1
12 VDC INPUT
GND
C1 4.7uF
C2 0.1uF
C3 0.1uF
C4 4.7uF
C11 4.7uF
C12 0.01uF
C13 0.01uF
C15 0.0
VIN GND ON/OFF
VOUT BYPASS
R6 1k
R7 1k
C17 0.01uF
C18 0.01uF
U4
SDA
Vc OE GND
Vdd CLK- CLK+
SCL
C16 0.01uF
R8 100
U5 FIN1002
Vcc
GND
C19 0.01uF
R9 10k
R10 10k
U6 74AC74
CLK /CLR /PRE
Q /Q
C21 0.01uF
C20 4.7uF
C14 4.7
570 (LVDS version of device)
se CMOS version of Si570:
ove R8 and U5 from circuit
jumper between hole of R9
and hole connected
U5 pin 5.
C28 0.1uF
C29 220pF
R19 4.99k
R15 1k
C30 220pF
R20 4.99k
U8 LT6231CS8
C32 0.1uF
R22 100
AUDIO OUT I
TO TIP OF AUDIO CABLE
GND
C31 0.1uF
R21 100
AUDIO OUT Q
TO RING OF AUDIO CABLE
C23 0.01uF
C24 4.7uF
C25 0.1uF
R16 1k
R11 10k
C22 0.01uF
S0 S1
1B1 1B4 2B2 2B3
1B2 1B3 2B1 2B4
1A 2A
/OE1 /OE2
U7 FSI3253
R14 10
R13 10
R17 10
R18 10
C27 0.047uF
C26 0.047uF
R12 100
/RXEN
GND
NT RETURN
NT INPUT
J1
1 2 3 4 5 6 7 8 9
spare
P100 P101
T100
C101
C100 L100
BPF module
SoftRock Projects
SoftRock Lite+USB Xtall v9.0
Tony KB9YIG
Rev 1
9/24/08
Page 1 of 3



Theory of Operation

- This receiver is patterned on the classic "direct conversion" receiver, in that it mixes incoming RF down to audio frequencies by beating the RF against a Local oscillator such that the mixer products are in the audio frequency range.
- Unlike the traditional DC receiver, the SDR does not "tune" the local oscillator's frequency to beat up against a desired RF signal. Instead, the local oscillator generates a fixed, "center frequency. The beauty of an SDR design is that the operator can, in one display, "see" all activity within the design bandwidth and immediately "click" on any interesting signal within that spectrum.
- This version (9.0) of the Softrock SDR receiver has a programmable local oscillator (U4 in the schematic below), permitting the operator to select any desired center frequency. Frequency selection is done in a SDR program on the PC, and implemented via a USB connection and

control circuit (U2 in the schematic below). The local oscillator is the Silabs Si570, of which there are two versions:

- LVDS - which requires U5, a high-speed, differential receiver that translates LVDS levels, with a typical differential input threshold of 100 mV, to LVTTL signal levels
- CMOS - which does not require the translation by U5

- While it would be tempting to use that frequency progammability to directly tune the oscillator to a specific desired frequency, the SDR design for Version 9.0 follows the SDR paradigm of providing a "chunk" of spectrum that is simultaneously detected and presented for processing in the PC. To accomplish this, the SDR hardware must present the "chunk" of spectrum as two down-converted chunks of AF in quadrature, the "I (in-phase) and the "Q" (quadrature) outputs.
- Most SDR designs use the concept of a center frequency, on either side of which are arrayed the "chunk" of received frequencies in a "chunk" of the RF spectrum. For any desired center frequency, the oscilllator (U4 - red shaded area below) generates a frequency equal to 4 times the desired center frequency. This signal is fed to a divider chain (U6 - blue shaded area below) that divides the input by 4 (with attendant phase shifts to achieve quadrature). The divider chain then outputs two signals at the desired center frequency and one-fourth of the input frequency. These two center frequency signals are in quadrature - each identical, differing only in phase by 90 degrees.
- The two center frequency signals are passed to the mixer stage (U7 - green shaded area below), where they are mixed with and beat against the RF input from the band pass filter stage (BPF Module, blue-green shaded area below), resulting in two down-converted products that are quadrature AF analogues of the incoming RF signals. As a result, the mixer products can vary in audio frequency from zero to +/- some theoretically high audio frequency.
(Note: the pluggable bandpass filters may be replaced by the new switchable , which implements 4 switchable BPFs on a single board, which can be manually switched or (once firmware is updated) switched via USB control.)
- These AF signals are then amplified in an inverting operational amplifier (U8 - grey shaded area below) to produce the I and Q signals for consumption and digitization by the PC's sound card.
- The practical bandwidth achievable by this design is limited by the band pass filters and is one-half the soundcard's maximum sampling rate.
- The "tuning" , image rejection, demodulation, AFC and other neat radio functions happen in the software part of the Software Defined Radio. It is the magic of Software that makes for the extraordinarily high selectivity in the direct conversion hardware (which is notorious for great sensitivity but terrible selectivity). The software allows the display of the audio frequency manifestations of the RF "chunk" on a display calibrated in the RF domain and centered on the center frequency. It "pivots" the digitized I and Q audio signals around the center frequency, such that the signals that (in RF) were below the center frequency are displayed to the left of the center frequency and those that were (in RF) above the center frequency are displayed to the right of the center frequency. Since these mixer products are difference products, the single drawback of the SDR design is that any signals that are precisely ON the center frequency are inaccessible without changing the center frequency.

(4 of 4 blank)

V9.0 Revisions

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Revisions to the Pages/Documentation

This page provides a log of activities in concurrent building, debugging, and documenting the kit, identifying changed web pages and describing the changes/status.

Page	Revised Date	What Changed
USB	10/07/2009	Updated firmware and PC USB Control software references to reflect the new approach using the PE0FKO architecture.
Home	10/07/2009	Added link to allow user to download a PDF version of these notes. Tx to Craig AB9IV.
USB	10/02/2009	Added caveat on soldering U2 Socket to ensure good ground. Tx to Nico ZS1KT!
LPF	6/1/2009	Clarified testpoints in T100 continuity test. TX to Jan Moller K6FM for suggestion.
USB Control	3/31/2009	Removed Rocky Test from USB Stage due to issues with testing USB Control of Si570 before it was installed. TX to Larry WB4HLX, Peter G3JRH, and others.
Local Oscillator, USB Control	12/19/2008	Moved R6 and R7 out of LO stage and put them in the USB COntrol stage to make pullup resistors available for USB testing. Tx to Jan G0BBL
Local Oscillator, Downloads	12/8/2008	Corrected expected pk-pk voltage on test of Si570 output. Author's measurements were way off due to cheapo scope and huge overshoot. Added warning not to try scope measurements without a good scope & probes & adult supervision. Tx to Van W1WCG for catching this
USB	11/27/2008	Changed voltage tests to reflect Jan G0BBL's results, Added simple USB polling test using AM radio.
[illegible], [illegible]	11/14/2008	Switched FL2 and FL3 locations to agree with latest schematic
Multiple	11/04/2008	Added [illegible] from each stage's schematic section.
02 USB Control, 00 BOM,	11/04/2008	Updated pages to reflect new zener diode design on USB-2 and USB-3 leads, replacing original 1N5227B values with BZY55s.

schematic		
02 USB Control	10/20/2008	The J3 connector on the v9.0 board is actually two header pins and not the sockets shown in the photos. This oversight will be corrected in subsequent updates to the site's photos. Thanks to Tony Parks for catching this.
External Connections	10/18/2008	Posted completed and tested [illegible] Connections and Final Smoke/RX Test pages.
Home	10/16/2008	Added link to excellent site with tutorials on all aspects of soldering. Thanks to Craig KB5UEJ for passing this on to this site.
06 RX Mixers	10/17/2008	Posted completed and tested [illegible] pages.
05 RX OpAmps	10/16/2008	Corrected errorneous reference to R20 (should have been R16) in test of [illegible]. Thanks to Serge RW3ACQ whose eagle-eye cought the error.
05 RX OpAmps	10/16/2008	Posted completed and tested Stage 5 [illegible] Operational Amplifiers) pages.
04 Dividers	10/16/2008	Posted completed and tested [illegible] pages.
03 Local Oscillator	10/15/2008	Posted completed and tested [illegible] Oscillator) pages.
02 USB Control	10/15/2008	Posted completed and tested [illegible] pages.
01 Power Supply	10/12/2008	Posted completed and tested [illegible] Supply) pages.
Home, USB, BOM, Schematic	10/08/2008	Modified schematics and BOMs to reflect changes between 9/24 and 10/2 and 10/8 versions. Modified Terse build notes to reflect changes on 10/8 sheet 3
PS, LO, DIV, OpAmp, Mixer	9/29/2008	Added caveat on testing sections of stage build pages: "This testing section if tentative and the values shown should be taken with a grain of salt, as the author has not yet progressed a build of the V9.0 kit through this stage. When the testing section is validated by the author's build experience, this note will be removed and the change will be noted on the revisions page".
Multiple	9/28/2008	Added links to datasheets for and orientation pictures of SMT ICs.
Multiple	9/26/2008	Added clickable links to the schematics. e.g., can click on "To Dividers" link on the LO page's Stage schematic and link over to the Dividers page.
Multiple	9/26/2008	Updated theory of operation and summary build instructions; annotated sub-schematics

Multiple	9/26/2008	• Filled in most pages with enough detail to get started. • Have not yet received Beta kit so have not incorporated build experience yet. • Most tests are from V8.3 RX. • USB tests haven't been vetted yet. • Still have to do connection page and page on full Software setup.
All	9/25/2008	baseline

Softrock Lite + USB Xtall V9.0 USB Control Stage

Revision date: 28 Nov 2009

Introduction

Theory of Operation

This stage provides the control interface between the hardware SDR and a PC that is running the appropriate SDR software which can provide [illegible] (Inter Integrated Circuit) bidirectional control signals over a USB connection. There are two lines in the I2C bus: the clock (SCL) and the date (SDA). For a more in-depth discussion of the I^2C protocol, see the formal [illegible].

The heart of the control circuit is U3, an [illegible] (caution! the pdf for this device is over 4MB). The unit is powered off of the PC's USB 5 Vdc bus and provides a 6 bit bi-directional I/O port. It draws less than 10mA. The two zeners are to protect the PC USB port, not the AVR chip, as that runs off a 5V supply. They are there with R1 and R3 to limit the USB signals to the PC to nominal level of 3.6v maximum.

R6 and R7 are pullup resistors that keep the control pins (SCL and SDA) of the Si570 at 3.3V. The AVR pulses them low when it communicates.

U3 uses and comes pre-loaded with the Firmware by Fred PE0FKO to perform the following functions:

- Accept control signals via the pins 2 and 3 of the Universal Serial Bus (USB)
- Translate input signals into I^2C control signals (bi-directional SDA and input-only SCL lines) for the Si570 programmable Oscillator
- Translate output I^2C signals from the Si570 back to USB signals to the PC
- Translate incoming bandswitching commands into appropriate signals to J3 (for control of the new HF-BPF board
- Future: [illegible] is being developed to implement automatic band switching of the new HF-BPF switchable BPF

Update

Several builders have experienced issues with the voltages on the USB-2 and USB-3 lines and diodes D2 and D3. Following a long series of [illegible], Jan G0BBL and Tony KB9YIG have decided to address the issue as follows:

3.3 U smt

3.6U

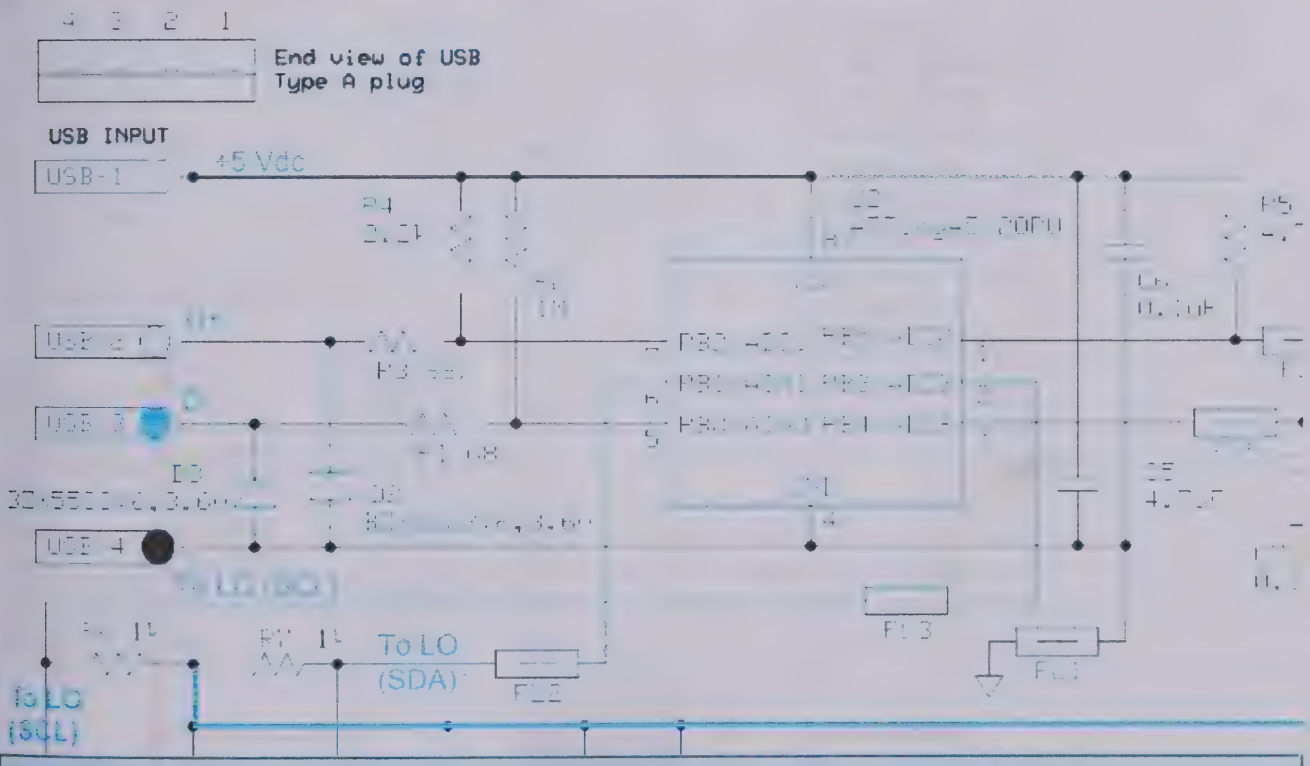
621-BZY55C3V3

C3V6

- Each new kit will be packed with two each of the BZY55 3.3 volt and 3.6 volt zener diodes in place of the two 1N5227B zener diodes for the D2 and D3 locations.
- Builders are advised to try the 3.6 volts BZY55 zener pair for D2 and D3 first, (marked on the glass body with 3V6), and if they still have USB communications reliability problems then go to the 3.3 volt BZY55 zener pair.
- Problems recognizing USB: Nico ZS1KT reports that a commonly experienced problem, where builders have completed their rigs and they have been working and then suddenly the USB device is no longer recognized, was due to poor solder joint(s) on the socket for the AVR (ATTinyxx) chip. In his case, the ground pin (4) was not well-soldered and the chip could not see a good ground. This often happens because builders are using the same heat setting they use on the sensitive SMT parts. This turns out in many cases to be insufficient to provide a good, permanent solded joint onto the ground plane.

Schematic

This is a subset of the overall schematic. Note: red dot indicates resistor testpoints (hairpin, top, or left-hand lead)



Bill of Materials

Designation	Value	Color/Code	Orientation	Category	Notes
C06	0.1uF			SMT 1206	black marked strip
C07	0.1uF			SMT 1206	black marked strip
C08	0.1uF			SMT 1206	black marked strip

FL1	ferrite filter			SMT 1206	
FL2	ferrite filter			SMT 1206	
FL3	ferrite filter			SMT 1206	
FL4	ferrite filter			SMT 1206	
FL5	ferrite filter			SMT 1206	
D2	1N5227B,3.6v		N-S		do not use
D3	1N5227B,3.6v		S-N		do not use
D2	BZY55,3.3v		N-S		See "Update" note in Introduction Section, above.
D3	BZY55,3.3v		S-N		See "Update" note in Introduction Section, above.
D2	BZY55,3.6v		N-S		Use this. See "Update" note in Introduction Section, above.
D3	BZY55,3.6v		S-N		Use this. See "Update" note in Introduction Section, above.
C05	4.7uF	475		ceramic	
R01	68 1/6W		S-N		
R03	68 1/6W		S-N		
R05	4.7k 1/6W		E-W		
R02	1M 1/6W		S-N		
R04	2.2k 1/6W		S-N		
R06	1k		S-N		
R07	1k		S-N		
U2	ATTiny45-20PU				with socket
J3	2 pin header				
cable1	USB				4 wire shielded USB cable with USB male on 1 end

Summary Build Notes

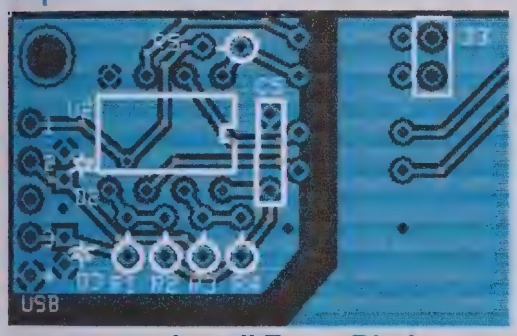
- Install Zener diodes D2 and D3 (top)

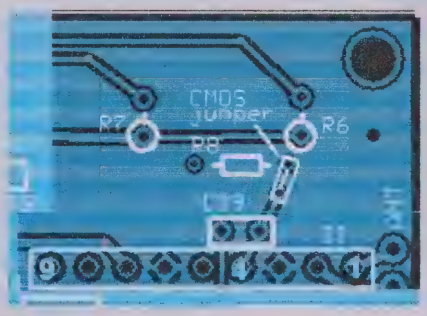
- Install resistors and C5 ceramic cap (top)
- Install U2 and socket (top)
- Install J3 (top)
- Install and connect USB cable (top)
- Test the Stage
- Install SMT capacitors and ferrite filters (bottom)

Detailed Build Notes

In other stages, we prefer to begin with the bottom side of the board. However, in this stage, the thru-holes for the topside coponents are very close together and are just begging to get solder splashed into them if we were to install the SMT components first. Thus, in this stage, we have reversed the bottom-then-top sequence.

Top of the Board





Install Zener Diodes

Several builders have experienced issues with the voltages on the USB-2 and USB-3 lines. Jan G0BBL and Tony KB9YIG have decided to address the issue as follows:

- Each new kit will be packed with two each of the BZY55 3.3 volt and 3.6 volt zener diodes in place of the two 1N5227B zener diodes for the D2 and D3 locations.
- Builders are advised to try the 3.6 volts BZY55 zener pair for D2 and D3 first. (marked on the glass body with 3V6), and if they still have USB communications reliability problems then go to the 3.3 volt BZY55 zener pair.

The two zener diodes are mounted hairpin style, with the cathode (banded) lead forming the hairpin.

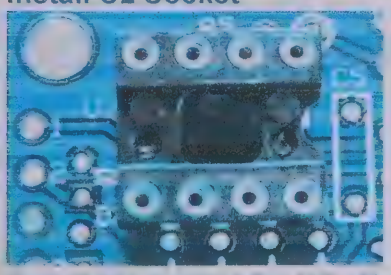
Designation	Value	Color/Code	Orientation	Category	Notes
D2	BZY55,3.6v		N-S		Use this. See "Update" note in Introduction Section, above.
D3	BZY55,3.6v		S-N		Use this. See "Update" note in Introduction Section, above.

Install Resistors and ceramic capacitor C5

Note: 1/6W resistors are used due to the tight spacing of the resistors on the board.

Designation	Value	Color/Code	Orientation	Category	Notes
C05	4.7uF	475		ceramic	
R01	68 1/6W		S-N		
R02	1M 1/6W		S-N		
R03	68 1/6W		S-N		
R04	2.2k 1/6W		S-N		
R05	4.7k 1/6W		E-W		
R06	1k		S-N		
R07	1k		S-N		

Install U2 Socket



Install the socket for U2. Note the orientation on the notch, which should face

eastward on the board

Install J3

J3 is reserved for a future use to provide control signals to the new HF_BPF (electronically switched bandpass filters) kit. Note: J1 through J3 all mount on top of the circuit board with the short pins through the board for soldering the connector in place.

Designation	Value	Color/Code	Orientation	Category	Notes
J3	2 pin header				

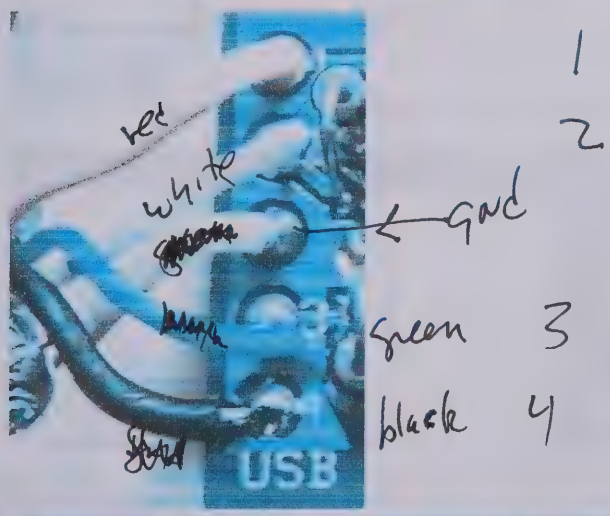
Install USB Cable

Solder a piece of hookup wire to the cable's shielding (see yellow lead in photo below) to serve as a strain-relief for the cable. Solder the strain-relief into the hole between leads 2 and 3.

Solder the USB cable leads in the order of red, white, green, and black to holes marked, respectively, 1, 2, 3, and 4

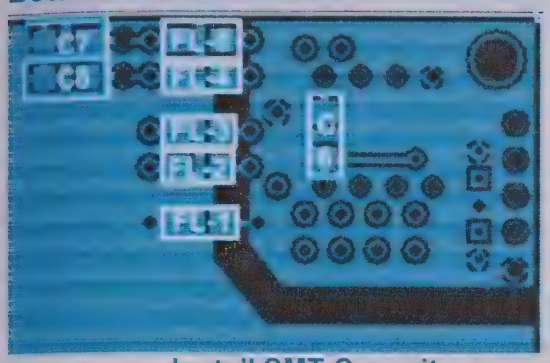
After soldering, carefully check (with good lighting and magnification) to ensure:

- you have not accidentally switched the wires from the sequence shown above (red, white, yellow, green, black
- you have no solder bridges on any of the connections or across to either of the two zener diodes.



Designation	Value	Color/Code	Orientation	Category	Notes
cable1	USB		End view of USB Type A plug Black Green White Red		4 wire shielded USB cable with USB male on 1 end.

Bottom of the Board



Install SMT Capacitors

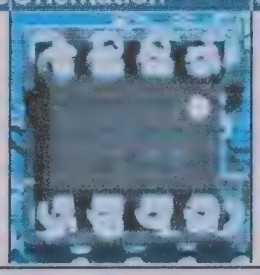
Designation	Value	Color/Code	Orientation	Category	Notes
C06	0.1uF			SMT 1206	black marked strip
C07	0.1uF			SMT 1206	black marked strip
C08	0.1uF			SMT 1206	black marked strip

Install SMT Ferrite Filters

Designation	Value	Color/Code	Orientation	Category	Notes
FL1	ferrite filter	grey		SMT 1206	
FL2	ferrite filter	grey		SMT 1206	
FL3	ferrite filter	grey		SMT 1206	
FL4	ferrite filter	grey		SMT 1206	
FL5	ferrite filter	grey		SMT 1206	

Plug in U2

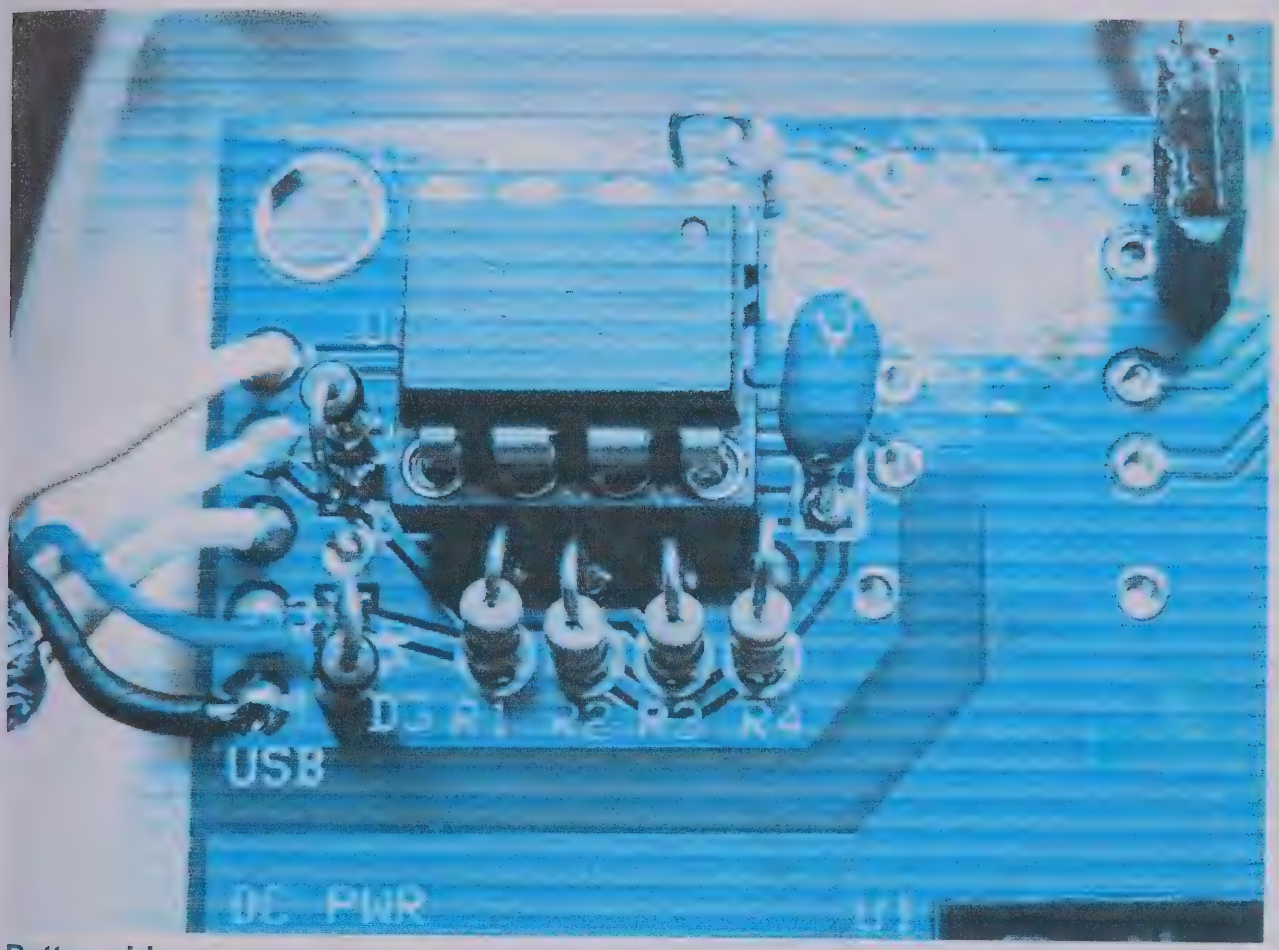
Note orientation - pin 1 is designated by the dimple/dot (see below)

Designation	Value	Color/Code	Orientation	Category	Notes
U2	ATTiny45-20PU				with socket

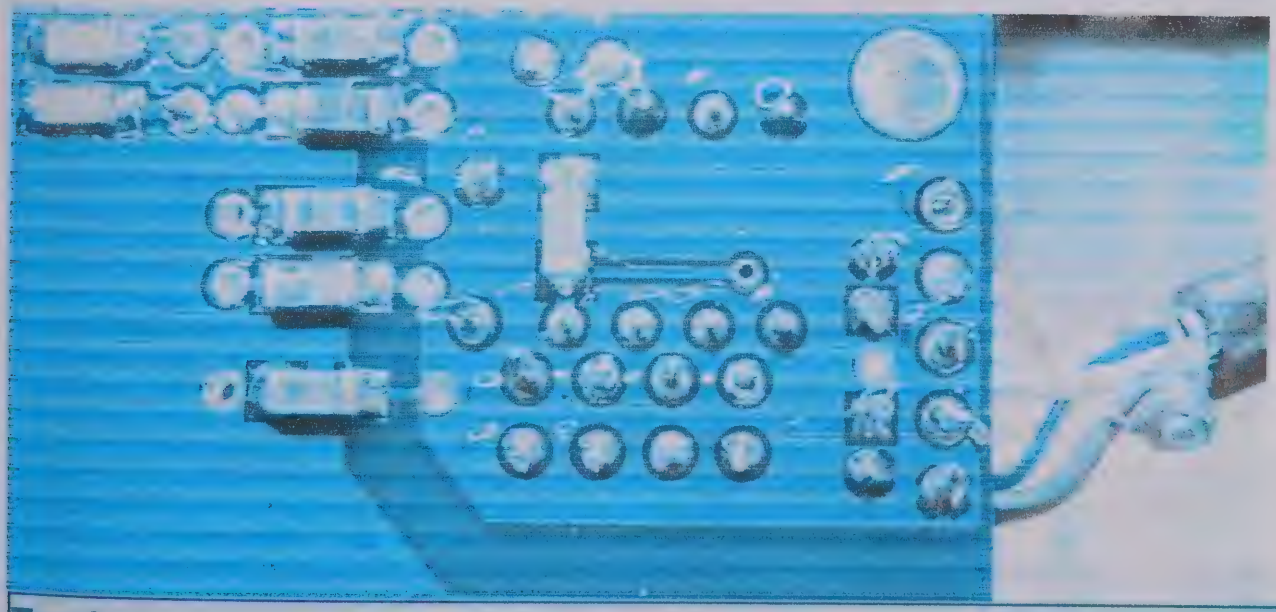
Completed Stage

Topside

(Note: resistors R6 and R7 not shown below - see completed topside picture of next (LO) stage)



Bottomside



Testing

Resistances

Test Setup

Make sure the USB cable is NOT connected to the PC

Documents / Downloads / Redfree USB

Test Measurements

Testpoint	Nominal Value	Author's	Yours
R5 hairpin to ground	~∞ Ω	starts ~34 MΩ (increasing to ∞)	_____Ω
R5 hairpin to USB-2	2.268 kΩ	2.269 kΩ	_____Ω
R5 hairpin to USB-3	~1 MΩ	990 kΩ	_____Ω

Voltages

Test Setup

If the resistance tests are successful, plug in the USB cable to the PC USB port and test the voltages

Voltage Test Measurements

(actual values may be +/- 10% of nominal values)

Testpoint	Nominal Value	Author's	Yours
R5 hairpin (U2-8) to ground	5 Vdc	4.96 Vdc	_____
R1 hairpin (U2-5) to ground	60-100 mVdc	96 mVdc	_____
R3 hairpin (U2-7) to ground	2.5-3.0 Vdc	2.54 Vdc	_____

USB Polling - Courtesy of JAN G0BBL

Test Setup

Plug in the USB cable to the PC USB port

Test

The USB polling can be checked. Connect a short piece of wire to R3 hairpin and an audio tone should be audible as a S9 Plus signal on a RX in AM Mode tuned to about 1100 KHz in the AM Band (Medium Wave Broadcast band)

Test End

Unplug the USB cable from the PC

R Chip Configuration

tall the USB driver software on your PC

ou have not already done so, install the latest USB driver on your PC. This driver is found at Kroon's PE0FKO website in a USB driver zip file. The file is located quite a ways down in the page (hint: do a "Find" on "Installing the PC driver software" to get to the link to the latest PC er zip file).

vnload the zip file and extract the it to a temporary directory (on the Desktop). Then, plug in device and it will show "Found new hardware DG8SAQ-I2C". Direct Windows' driver allation wizard to the directory where the software was temporarily stored and finish installing driver.

pe0fko.nl/CFGSR/

nfigure the AVR Chip

s step involves downloading an executable program and an associated DLL and running the gram to configure the AVR chip to your desired settings.

- Download the following from Fred's CFGSR web page into the directory of your choice (hint: do a "Find" on "Download"):
  - Fred PE0FKO's Configuration Tool Program: CFGR.EXE

DOCUME~1\JamesB~1\locals~1\Temp\USB synth

1/23/12 2:55 PM

location of extracted files

- Softrock DLL(to handle the protocol and the USB interface): SRDLL.dll

- Run the CFGR.exe program and follow the hdsdr

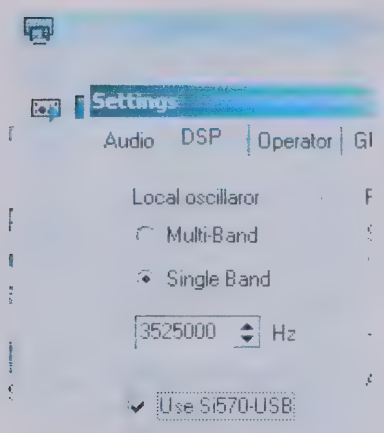
try www.hdsdr.de

Functional Test Setup

The functional testing of this kit assumes you will be using the SDR program to control your Local Oscillator and set your center frequencies.

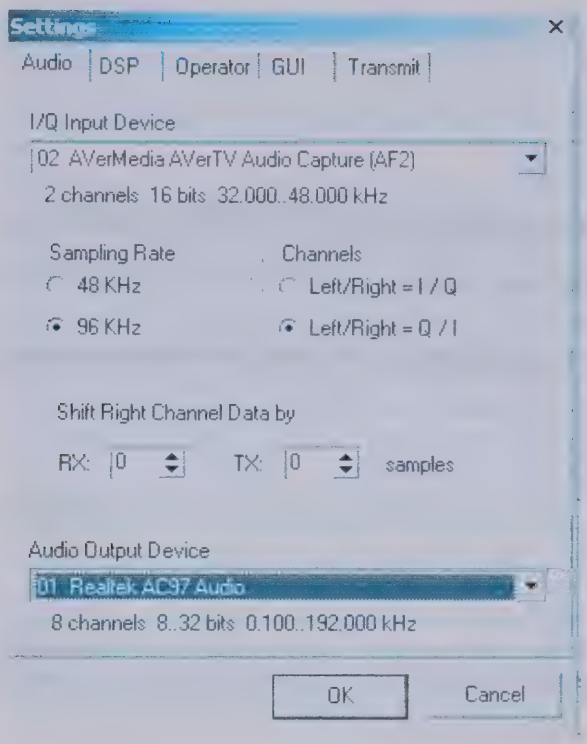
The following steps outline how to set up Rocky for this (and later) tests:

- Download and install it
- Run Rocky and enable the Si570 support in Rocky by ticking the "Use Si570-USB" check box in the Settings/DSP dialog. Do not change the "address" and "divider" settings.

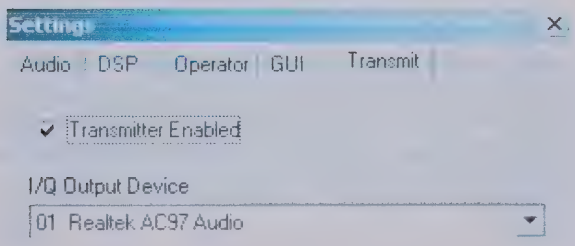


- In the In the "Hz" fiield, type in `7046000` to set Rocy's default center frequency to 7.046 MHz.
- Set up Rocky for RX=only:
  - Click on `View/Settings and the "Audio" tab`

driver download
libusb-win32-bin-1.2.6.0



- Select the "`I/Q Input Device`" to be the your on-board sound card
- Select the "`Audio Output Device`" to be your on-board sound card
- Click on the "`Transmit`" tab



- Clear the "`Transmitter Enable`" checkbox to disable transmit mode

The PC is now set up to use Rocky to control the Si570 Local Oscillator.

8 USB CONTROL of the SI570 (Used 2009 on) Current version, *Fred PE0FKO's version of the USB controller see below.*

Another of Robby's pages, **all models, USB driver installation and testing. September 2010 If this does not help, look below.**

Sept 2010 Installing the driver.

And/or:- Driver Installation **go to at the bottom it describes the basic driver installation. Get this from *Load drivers:-* Unpack the drivers into a folder on your computer. Insert USB plug and direct the "Wizard" to the SI570_firmware folder. Then the drivers are installed. If you miss this and the driver does not get installed go to "Device Manager", find the "Unknown USB Device" and "Update the Driver", directing it to the folder. Occasionally it may be necessary to find and delete the drivers. In XP they are at C:\Windows\System32\libus0.sys and libus0.dll, one of these in the "Drivers" folder.**

Windows-7 64bits July 2010 "The open-source group LibUSB-Win32 released the new and SIGNED version of the libusb0.sys library. Because it is signed it will also install on Windows-7 64bits. I did build a new driver install package and tested it on Windows-XP and Windows-7 64bits. Also changed the web-page to describe the installation process on Windows-7. With thanks to the LibUSB-Win32 group and Pete Batard (who is the developer of libusb-1.0) for contributing the certificate!-- 73, Fred PE0FKO"

There was a small problem in the package when installing on Windows-Vista. Its is now solved, and I hope SoftRock will now work on the many Windows versions available. URL

Once you have the USB driver installed and got the interface correctly recognised by the PC, the firmware default state is to support the v9.0 and Ensemble RXs and switched BPF filter module, so no changes are necessary. BUT for RX/TXs CFGSR must be used to disable the Auto BPF feature.
If you need to make any changes or just want some more information about using the firmware, take a read of the 'Firmware Users Guide' and hopefully that should provide some guidance. You can download the user guide from Fred PE0FKO's website:

February 2011 Version 2.3 There is now a new stand alone configuration program called 'CFGSR' which you can download from:
with automatic installer and new guide detailing all the functions. Use with care but note any mistake can be remedied by a reset of the Si570 or the AVR.

***RX/TX with USB AVR:-** CFGSR, see above, is required to configure the device to enable CW TX. ABPF is for RX only and must be disabled.*

(8) Calibration:-*Setting Si570 frequency calibration.* **My page based on Bob's advice, note this will make it correct for all software. Bob's method is easy. In Europe RWM on 4.996, 9.996, & 14.996MHz is often good. Wait for the plain carrier which runs periodically for 8 minutes starting on the hour and half hour. Many of the major broadcasters have excellent accuracy *BUT MANY OTHERS DO NOT!!!!***

***June 2010 Only for those that want special BPF selection:-** There is a small bug in the firmware V15.12, that is in use for some 8 month's now, for that reason there is a new version V15.13 of the firmware available on my website . The bug is in the filter selection, if there is a other sequence needed than the normal increasing (0,1,2,3) one. In most of the Softrocks that will not be a problem, only for the people that will experiment with different filter settings. -- 73, Fred PE0FKO For programming or replacement see bottom of this section 8.*

How to setup the USB AVR firmware for the LF Ensemble **this also partly applies to the v9 with LF adaptor.**

Bob has all the information! *For Bob, G8VOI's, documentation:- PE0FKO SoftRock AVR Firmware User Guide Issue . Version 9.0 VHF converters and firmware set-up .*

(8) ***Fred's CFGSR is able to save your favourite start frequency.*** **If you feed power from the Softrock 5V then USB does not need to be connected for the Si570 to be started at this frequency. When the USB is connected it works normally. I use this feature for my Softrock monitoring RXs, set to an exact frequency then save it.**

A problem with the USB connection developed with my system. Answer - USB mouse!

Bob's explanation of the differences, and history, of the firmwares used in the ATTiny AVR. Comparisons with Fred's AVR supplied by Tony with the Softrock and the SDR Kit's AVR. Basically the advice is to use Fred's firmware for a Softrock. The early AVR supplied with the

Softrock will work but is best replaced.

Compatability with SDR KITS controller and early AVRs:- **"First there was the DG8SAQ firmware V1.4 then the PE0FKO firmware V15.x upward compatible with V1.4** ***then came SDR-Kits firmware V2.x *not* upward compatible with V15.x. -- 73, Fred PE0FKO"*** **So the later SDR kits controller may give problems when trying to use with some software. Jan. 2010.**

Getting a new AVR

(8)

TESTING **This message from Bob removes some confusion Re: V 9.0 Rx LO Stage (and all USB Softrocks) Test.**

A Beginners Guide to Programming the Atmel ATtiny . ***Note Fred's latest V12 onwards only fits on the ATTiny85 but you may find V11 will suit your purpose.***
If you do not want to reprogram older AVRs then Cecil will supply the AVRs with the software installed, just make sure he knows what you want.

CPU/Logic

Make sure that you have the 'ABPF' option selected in the firmware by using the set up screens in Winrad or the new (Sept 09) configuration utility. In PSDR-IQ v1.12.20, under the 'General' set up 'USB' tab, make sure you have both 'USBtoI2C adapter' and 'HF bpf' boxes ticked and applied. I have had the program clear one of these very occasionally for no obvious reason. It's worth updating your firmware up to the latest v15.10 as that will give you full bpf switching with Rocky v3.6 as well. Do not fit the 'manual' bpf selection jumpers with the lead still connected to J3 otherwise you might risk damaging the AVR chip as you could be shorting the output pins to 0V if they were high to start with. 73, Bob G8VOI

(8)

Installing the USB driver in VMware.

Switched BPFs Using the USB AVR chip. **Note:- This is old info, the latest AVR is different.**

As always I recommend keeping with Tony's kit until you know what the alternatives are. "There seems to be a lot of confusion and spurious information being given out regarding the v9.0 receiver and auto band switching! Advice being given out on this, and other related groups could be making people buy additional hardware that is not required. It is NOT necessary to replace the original AVR (Early 2009) chip supplied with the v9.0 kit to have control of the band switching with the following: Winrad using Fred PE1FKO's dll file, this works fine WITHOUT needing to change the AVR chip. PowerSDR using the dll from: http://

212.254.198.33/bpf_usb/ (No longer there.) Both of the above work fine. The new AVR chip from SDR-kits and PE1NNZ dll works fine with PowerSDR, (and also happens to work with Winrad using Fred's dll to provide band switching, but not the fine tune function). Unfortunately I do not have the facilities to program a chip with Fred's new firmware to try that out to compare with the above. As far as I know there are no simple solutions for using Rocky or KGKSDR and the auto bpf. Please note, I am not saying one or the other available AVR chip solutions is better or worse, each appear to provide enhanced facilities over the original one. Bob G8VOI"

For the independent controller. At Look at the compatability note above. The later version may not work with SDR programs. **This kit (November 2009) now has the option of a LVDS Si570 going up to 915MHz. NOTE:-** The early version is the same as Tony's USB controller. The drivers here are for **early** versions of Tony's USB AVR. **Note:- The drivers only work with the version of PSDR linked on that site. The AVR is best replaced with the latest Softrock version and Fred's driver/dll.** This controller may be interfaced to a Softrock without an Si570. Here you can download "SOFTWARE AND SCHEMATICS:" SI570_firmware.zip. Extract this to a convenient place. Click "Easy to use PC software" this gives you USB_Synth.zip. Extract the .exe. This enables one to set the frequency independent of an SDR program. (This sets the Si570 to any frequency within its range, try outside their specification, I have at least one of Tom's LVDSs that goes to 700MHz (or higher?)

ALL THIS IS IN THE PDF At Click "SDR-Synthesizer Kit Documentation (PDF File)" about 3/4 way down the page, for "USB-Synthesizer Kit Instructions v10.PDF" and "USB Synthesizer Kit Update 1" for USB Synthesizer Kit Update 1.PDF

For Tom, DG8SAQ's ***USB troubleshooting*** this includes a link to M$ usbview

Included in the software is a USB test program. It will read the Si570 so its frequency could be set, then the registers read to be transferred to a PIC for specialist use. TOM WARNS, "DO NOT USE ANY OTHER BUTTONS ON SI570_USB_Test UNLESS YOU EXACTLY KNOW WHAT YOU ARE DOING. YOU MIGHT CORRUPT THE AVR EEPROM". See his PDF!

Si570 Type:- It is recommended to use the CMOS with this kit, but if you have the LVDS it may be used with Softrocks. Look at The LVDS has slightly higher specifications but the difference may not be noticed. The more adventurous could use a receiver like the FIN1002.

Early 2009 Tony's add-on board to interface USB with the Si570 on his earlier kits.

Construction and other information here:-

This is likely to be the best way to control it, just plugging in where the PIC goes. As in many of these sort of additions the source is available for those who wish to develop further, or customise. NOW OT OF DATE! This board now comes with Fred's firmware AVR, not the SDR Kits version, *see top of this section*. This board did use the controller from SDR Kits *so the DG8SAQ software above also worked with it*.

"The electrical connections to the PC from the v8.4 board involve only the soundcard line-in cable and the two data lines in the USB port connection. This results in only a single ground connection between the v8.4 board and the PC, the ground in the line-in cable. With only a single ground connection to the PC the center frequency noise is very low, however, the USB control of the Si570 seems to be good."

Since then problems have been noted, ***Jan 2010 hopefully all is cured, I keep this here just in case it helps someone!*** I rectified a lack of control by connecting a 100nF between the two grounds, Tony has used some filtering in the v9.0 Lite. TONY IS REPLACING THE ZENER DIODES IN THIS UNIT, THEY SEEM RESPONSIBLE FOR INTERMITTENT OPERATION. ***See*** A further problem may be the result of the SCL I2C line not being pulled high. Many find powering the Softrock BEFORE inserting the USB solves this. Two solutions to this, pull the SCL line to the USB 5V rail with a 47K. Just this line needs pulling high. Or revised software for the ATTiny at Cecil can supply a chip with this new software, ask him:-

Early 2009 **NOW OUT OF DATE**! Now Tony's Softrock v8.4 and later come with integrated USB control. This is the same unit, ***all the information required for the Softrock is on this site*** **Look carefully, <u>everything</u> is there!** This also applies to the add-on **XTALL USB board** for early Softrocks. ***June 2009 Tony is now supplying Softrocks with Fred, PE0FKO's USB AVR firmware, see top of this section. Note this needs Fred's driver.***

Common Component Mounting Instructions

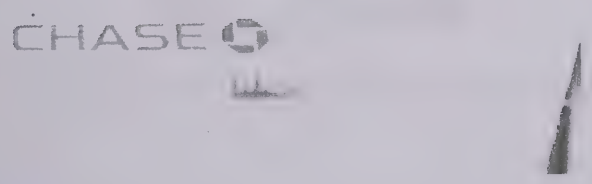
This page provides guidance to the builder on common components encountered Introductionbuilding the Softrock series of SDR kits. Click on the links below for techniques/tips on:

-
-
-
-
-
  -
  -
-

Resistors

The resistors are mounted with one of five orientations. The first four are the "hairpin" style, where the body of the resistor is snugged up against the board at the location indicated by the silkscreened circle and the other lead is bent into a hairpin shape and inserted into the hole pointed to by the small line on the resistor's silkscreened circle.

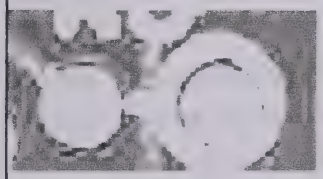
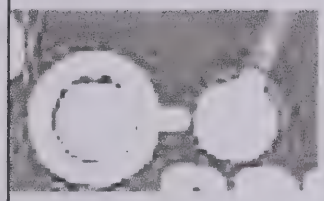
You can put a neat hairpin on a resistor lead by holding the resistor against a credit card and bending the lead over the top of the credit card and back down. In doing so, You want to keep the top of the hairpin as short as possible (e.g., no longer than 1/8"). See images below:

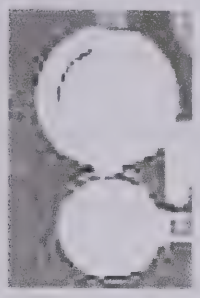
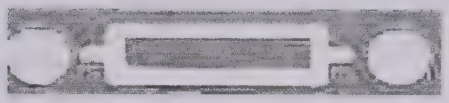


Hairpin resistor orientations are described in "to-from" terms, indicating the direction the hairpin is pointing in relation to the resistor's silkscreened circle. For example, "east west" means the resistor is mounted hairpin style with the hirpin lead to the west (left) of the body.

The fifth resistor orientation is "flat" ("flat-h" being horizontal and "flat-v" being vertical, with respect to the top edge of the board).

The pictures below illustrate these mounting techniques:

Orientation	Silkscreen	As Mounted
East-West ("E-W")		
West-East ("W-E")		

Orientation	Silkscreen	As Mounted
North-South ("N-S")		
South-North ("S-N")		
Flat ("flat-h" or "flat-v")		

Ceramic Capacitors

Values

Ceramic capacitor value codes are typically expressed as three digits where the first two digits are the significant figures of the capacitor value and the third digit indicates how many zeros to add to express the capacitor value in pF. Examples would be:

- code 471 would indicate a 470 pF capacitor code 2
- 20 would indicate a 22 pF capacitor.

Ceramic Capacitor Value

1st Digit	2nd Digit	Multiplier Code	Multiplier	Tolerance Code	Tolerance
0	0	0	1	B	± 0.1pF
1	1	1	10	C	± 0.25pF
2	2	2	100	D	± 0.5pF

1st Digit	2nd Digit	Multiplier Code	Multiplier	Tolerance Code	Tolerance
3	3	3	1,000	F	± 1%
4	4	4	10,000	G	± 2%
5	5	5	100,000	H	± 3%
6	6			J	± 5%
7	7			K	± 10%
8	8	8	0.01	M	± 20%
9	9	9	0.1	Z	+80% / -20%

Installing the Ceramic Capacitor

- Lightly snug each capacitor as close to the board as the lead formation will allow.
- Slightly spread the capacitor leads on the bottom side of the board and solder one lead to hold the capacitor in position.
- Cut both leads flush to the bottom of the board and solder the second capacitor lead.

SMT Capacitors

- 0.1 µF carrier strip (note black stripe)
- 0.01 µF carrier strip (note: clear strip)

Most of the kits use both types. Do not get them mixed up!
All SMT capacitor locations on Softrock kit boards are to be filled with 1206 size capacitors. You want to do your work on a cookie sheet or other "pan" with sides so, if you accidentally sneeze or otherwise "launch" one of these tiny chips, you may still have a chance of retrieving it.

Removing Caps from the Carrier

Most SMT components are supplied on a "cut tape" carrier strip from a reel of parts. This tape is normally a paper or plastic backing with a clear plastic strip on top. Tony marks the 0.1 µF strip with a black stripe for identification.

The way that works best for most builders is to somehow get a grip on the plastic strip and carefully

seperate from the main strip. This will leave the exposed parts sitting in indents in the backing. Sometimes rather than just get one or two, you can take off the entire plastic strip so it won't somehow knock the rest on the floor !! The real trick is getting the plastic strip started: you can use your exacto knife or even a probe tip jabbed in the plastic. Takie care to avoid having the natural "springiness" of the carrier strip act as a slingshot that could launch the loosened chips into the air

Installation procedure is as follows for each SMT 1206 Capacitor

- Add a little solder to one pad and tack one end of a capacitor to a pad.
- Reheat and position the capacitor with the tip of the soldering iron and a toothpick.
- When the capacitor is properly positioned on its pads, solder the other end with enough solder to make a small fillet between the end of the capacitor and the pad.
- < Reheat the first end of the capacitor and add a little solder, if necessary, to make a small fillet at the tacked down end of the capacitor.
- Excess solder may be removed with solder wick.

Leonard KC0WOX has an excellent

Another very good video on Youtube by Steve "Soldersmoke" Weber KD1JV is viewable below:

Electro Static Discharge (ESD) Precautions

These ICs are very sensitive and subject to being destroyed by electrostatic discharge. You must use common-sense, protective ESD precautions when handling or working with these chips, such as:

- Avoid carpets in cool, dry areas.

- Leave PC cards and memory modules in their anti-static packaging until ready to be installed.
- Dissipate static electricity before handling any system components (PC cards, memory modules) by touching a grounded metal object, such as the recommended uncoated metal cookie sheet.
- If possible, use antistatic devices, such as wrist straps and antistatic mats (see Radio Shack's Set for $25 or the JameCo AntiStatic mat for $15)).
- Always hold a PC card or memory module by its edges. Avoid touching the contacts and components on the ICs.
- Before removing chips from insulator, put on the wrist strap connected to the ESD mat. All work with CMOS chips should be done with the wrist strap on.
- As an added precaution before first touching a chip, you should touch a finger to a grounded metal surface.
- If using a DMM, its outside should be in contact with the ground of the ESD mat, and both leads shorted to this ground before use.

Installation procedure is as follows for each Surface Mount Technology (SMT) IC:

- Orient the IC on its pads so that the pin 1 corner of the IC matches the small 1 (it also looks like a 0) mark in the copper on the bottom side of the board. In general, pin 1 of an SOIC packaged IC is in the lower left corner of the package when the printing on the package top reads upright, from left to right.
- Tack-solder one corner pin of an IC and reheat the tacked pin as necessary to line up the IC on its pads properly.
- Check the orientation of the IC and the line up of the IC on its pads with magnification and good lighting.
- If all is well, carefully solder the rest of the leads to their pads.
- Carefully and closely inspect the pins to look for bridges caused by excessive solder or debris on or around the pads.
- Use solder wick to remove any excess solder or solder bridges between IC pins.
- Using high (3x or better) magnification, carefully check each pad and solder joint.

Leonard KC0WOX has an excellent video on . The Sparkfun website also has some good video materials on s.

The video below describes techniques for soldering SOIC 14 (and 16 and 8) SMDs

Toroid Coils

Toroids

Identifying the toroids becomes simple once you figure out the coding. The toroids are designated using the pattern "T-NN-M". The critical pieces are the "NN", representing the outside diameter of the "donut" in hundredths of an inch, and the "M", representing the type of material used to make the core. Tony uses the following toroids in his kits:

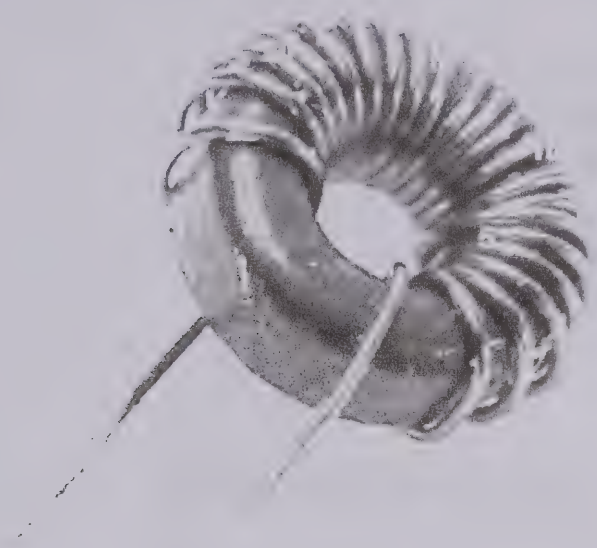
- T30-2 (red)
- T37-2 (red)
- T25-2 (red)
- T25-6 (yellow)
- T30-6 (yellow)

Toroids are used in single-winding coils and multi-winding transformers. In either case, the number of turns must be counted. Any pass through the center of the Toroid is counted as a "turn" (see below).

Coils

The winding of a single-winding toroidal inductor is fairly straight-forward. Each pass through the center counts as a turn. The windings should be spaced evenly around the circumfrence of the toroid, ideally leaving about a 15 degree "wedge" between the beginning and ending of the winding. The

image below is of a 22 turn coil wound on a toroid.



Occasionally, you may find that there is not enough room on the toroid to place all of the windings without having to go back and add a layer of winding. Tony Parks suggests that you overlap some turns as you put on windings around the circumference of the core so that all turns are on the core by the time you get back to the start end of the winding. This should have negligible effect on the coil's performance in the radio.

Leonard, KC0WOX, has an excellent (if large - 183 Mb!) of a 26 turn coil on a T-37 core. While the turns andcore size in the video are not used in any of the Softrock kits, the technique is essentially the same. The actual process of winding the core begins at about 8.5 minutes into the video.

Transformers

Winding toroidal transformers usually involves 2 to 3 windings on the same core. The most common is a transformer with a single winding (primary or secondary) over which two "bifilar" windings are superimposed (two secondaries or primaries). See the for good tips on how to wind a toroidal transformer.

When you have finished winding, stripping, and tinning the toroidal transformer's windings, you will two leads for each winding. Each lead will come out on a different side of the toroid. For example, consider a three-winding transformer with one primary ("P") and two secondary windings ("S1" and "S2"). It will have a total of six leads, three on one side of the toroid and three on the opposite side:

- The two primary leads, "Pa" and "Pb" ("P" stands for primary; "a" is one side of the toroid, "b" is the opposite side)
- The two leads for the 1st secondary winding, "S1a" and "S1b" ("S1" stands for the 1st secondary

						3- Output 2 - Gnd 1 -
☐	PCB	Main Board	SR Lite II (Combined) PCB	1		
☐	wire	Cutoff	shunt wire (cut-off lead)	1		

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Detailed Build Steps

Install SMT cap

Install C13 SMT 0.1 uF cap

Take care to avoid solder "splashover" that could clog up the thru-holes above and to the right of C13 (see red dots in above graphic)

See

Check	Designation	Component (top/bottom)	Orientation	Marking	Image	Band
☐	PCB	SR Lite II (Combined) PCB (top)				any
☐	C13	0.1 uF ((bottom))	white pads	(smt) black stripe		any

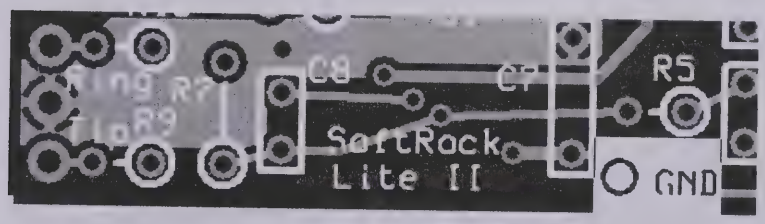
Install topside components

Install C1 and C2 (the two blue capacitors), U1, and D1. Install D1 such that the cathode end (the end with the band) is facing up and forms a hairpin. The hairpin lead will go into the square thru-hole (refer to the Completed Stage, Topside picture below).

See

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
					3- Output 2 - Gnd 1 - In
☐	D1	1N4003 (top)	E-W	1N4003	
☐	C01	4.7 uF 10% 16V X7R RAD (top)		475	
☐	C02	4.7 uF 10% 16V X7R RAD (top)		475	

Install ground test loop



Using a short length of cut-off resistor or capacitor lead, fashion a short wire loop and solder it to the "ground" hole, such that the loop is available on the topside to provide a ground point for tests.

Check	Designation	Component (top/bottom)	Orientation	Marking	Image	Ba
☐	gnd	shunt wire (cut-off lead) (top)				any

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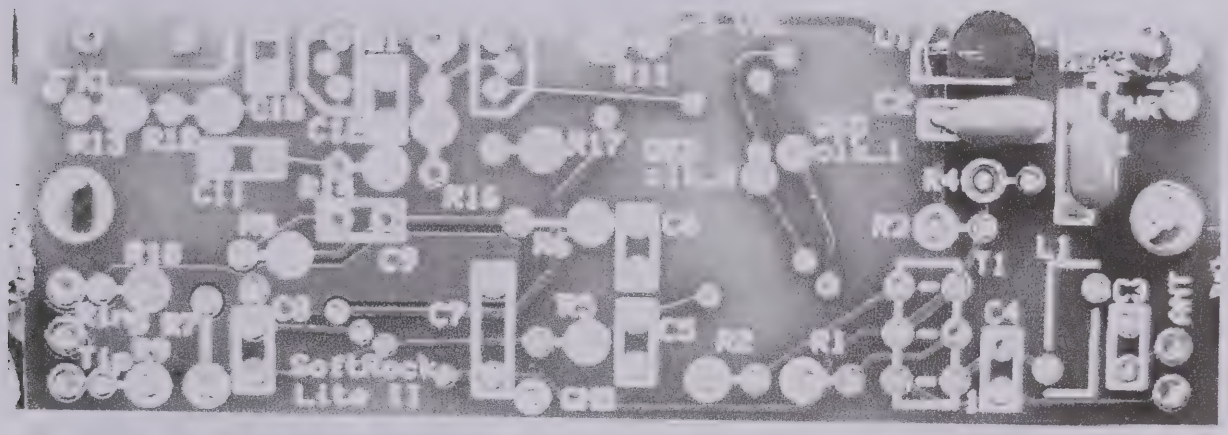
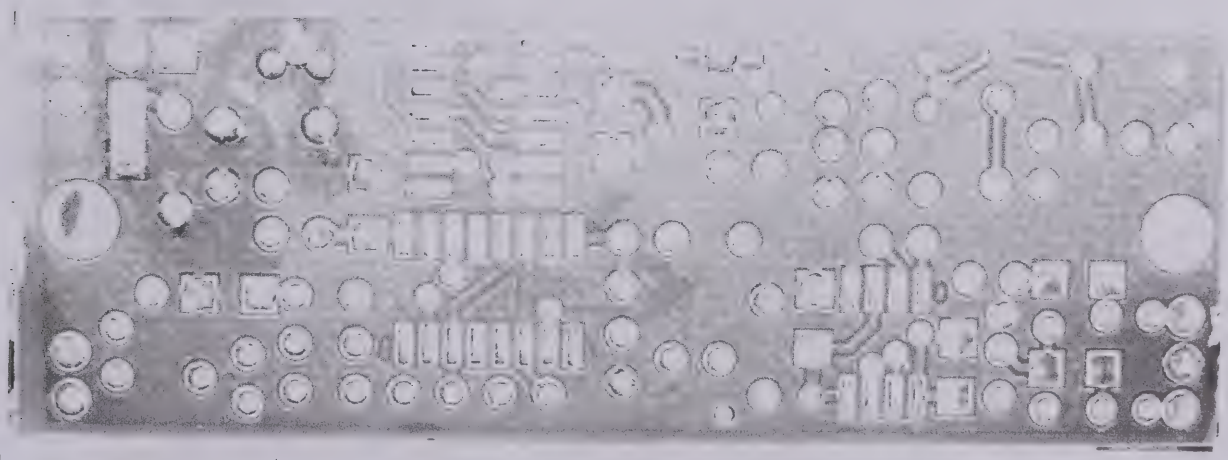
Completed Photos

Note: the completed pictures are of the 40m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside



View of Completed Underside



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Testing

Overview

Visual Inspection

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Test Procedure

Test for current draw in 2 ways:

- Use a 12 volt power supply
- In one test there is also a 1k resistor in the series "chain" as well.
- in the second test, the setup is the same except that the current-limiting resistor is removed

(measurements courtesy of Leonard KC0WOX)

Potential issues:

-
-

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1 □	With 1k Limiting resistor	mA	<9	4.1	_____
2 □	Without limiting	mA	3-6	4.4	_____

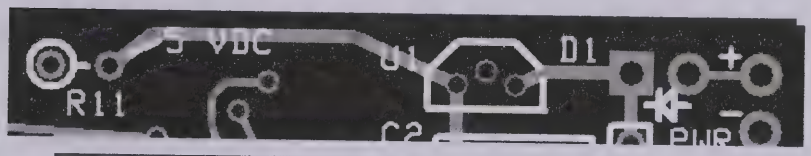
	resistor				

Voltage Test

Test Setup

Once the current draw test is successfully passed:

- Apply 12 Vdc (NO current limiting resistor) to the PWR + and - pads (upper right-hand corner of the board)
- Measure the voltage with respect to ground at the testpoints below



Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1 ☐	R11 hairpin (5 Vdc point)	Vdc	5	4.93	_____
2 ☐	D1 cathode (square hole)	Vdc	11-13	12.2	_____

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L.O.

MHz fundamental frequency and first harmonmic, but allows 20m signals centering around the third harmonic (14.0475) of the 4.6825 MHz LO output.

- The result is that the mixer is dealing with signals in the passband, centering on 14.0475 MHz, as though the dividers were passing a fundamental frequency of 14.0475 to the mixer. BPFs are all that stop Softrocks from working on unwanted frequencies!

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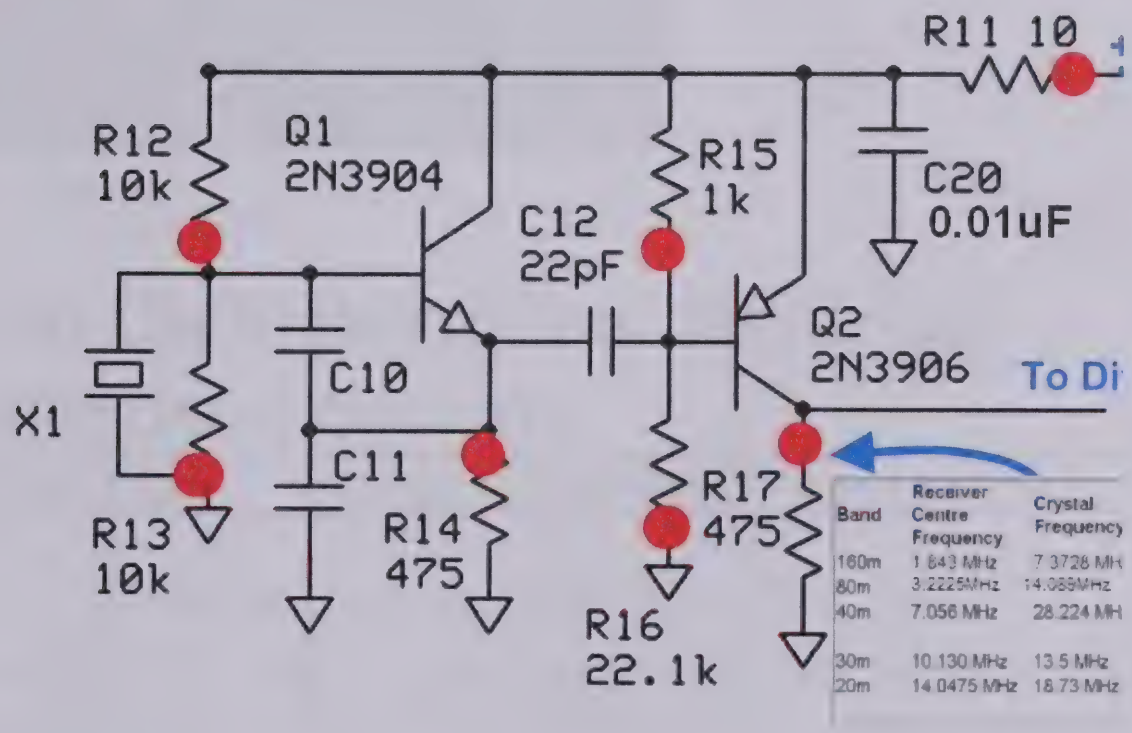
Stage Schematic



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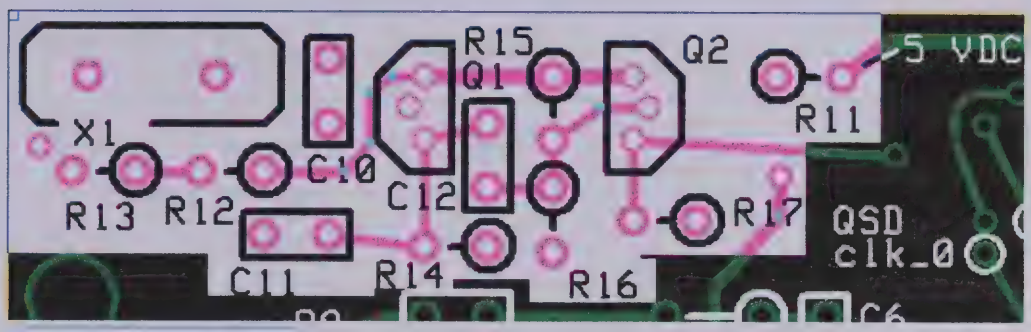
Board Layouts

Board Top



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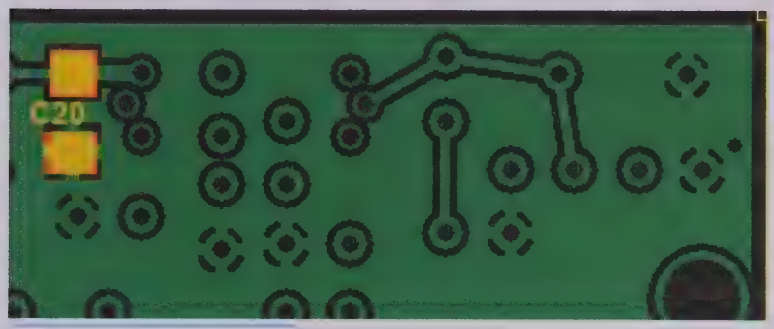
Board Bottom



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Local Oscillator Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking
☐	Capacitor	Ceramic	22 pF 5%	1	22J
☐	Capacitor	Ceramic	100 pF 5%	1	101
☐	Capacitor	Ceramic	180 pF 5%	1	181

☐	Capacitor	SMT 1206	0.01 uF	1	(smt) no stripe
☐	Resistor	1/4W	10 ohm 1/4W 1%	1	br-blk-blk-gld-br
☐	Resistor	1/4W	475 1/4W 1%	2	y-v-grn-bl-br
☐	Resistor	1/4W	1 k 1/4W 1%	1	br-blk-blk-br-br
☐	Resistor	1/4W	10 k 1/4W 1%	2	br-blk-blk-r-br
☐	Resistor	1/4W	22.1 k 1/4W 1%	1	r-r-brn-r-br
☐	Transistor	TO-92	2N3904 NPN Transistor	1	2N3904
☐	Transistor	TO-92	2N3906 PNP transistor	1	2N3906
☐	Xtal	Xtal	18.73 MHz	1	18.730 1108

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Detailed Build Steps

Install SMT cap

See hints on installing SMT Caps.

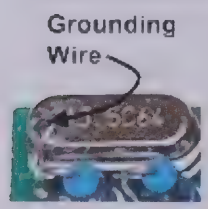
Check	Designation	Component (top/bottom)	Orientation	Marking	Ima
☐	C20	0.01 uF ((bottom))	yellow pads	(smt) no stripe	

Install Crystal

See Band-specific Components chart for value.

Mount the HC49 crystal mounting in the upper left corner of the board, mounting it vertically to the board. A small plated-through hole in the lower left corner of the crystal mounting position provides a place for a grounding wire to be soldered to the metal crystal case. The grounding wire also provides additional mechanical support for the crystal.

Make sure the crystal is mounted slightly above the board. You can use a piece of cardboard or wire insulation between the bottom of the crystal and the board to get the desired standoff distance while mounting X1.



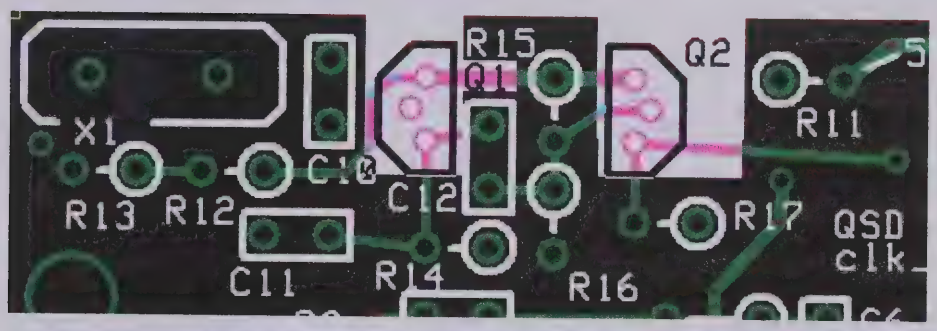
Check	Designation	Component (top/bottom)	Orientation	Marking	Ima

☐	X1	18.73 MHz (top)		18.730 1108	

Install transistors

Mount the two transistors being careful to orient them according to the pattern in the silkscreen.

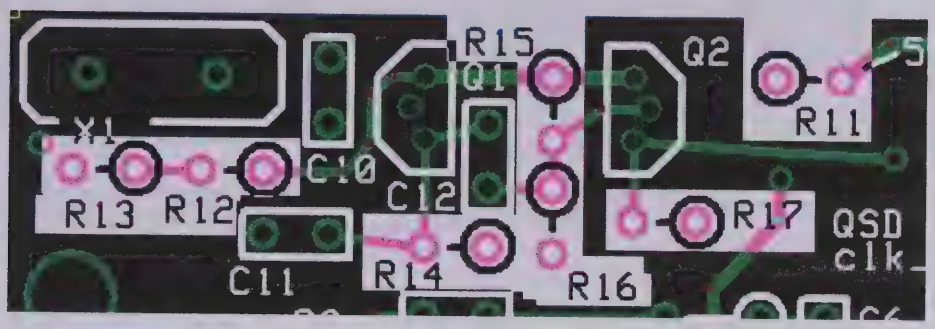
Take care not to get 2N3904 and 2N3906 mixed up. Carefully check the last digit.



Check	Designation	Component (top/bottom)	Orientation	Marking	Ima
☐	Q1	2N3904 NPN Transistor (top)		2N3904	C B E
☐	Q2	2N3906 PNP transistor (top)		2N3906	C B E

Install Resistors

See hints on installing and orienting resistors

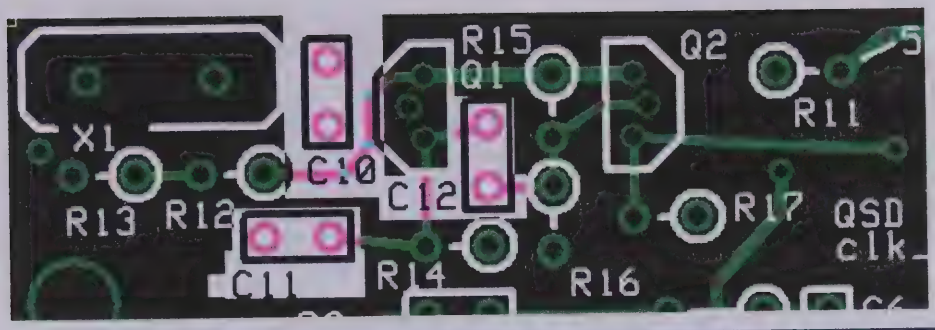


Check	Designation	Component (top/bottom)	Orientation	Marking
☐	R11	10 ohm 1/4W 1% (top)	W-E	br-blk-blk-gld-br
☐	R12	10 k 1/4W 1% (top)	E-W	br-blk-blk-r-br
☐	R13	10 k 1/4W 1% (top)	E-W	br-blk-blk-r-br
☐	R14	475 1/4W 1% (top)	E-W	y-v-grn-bl-br
☐	R15	1 k 1/4W 1% (top)	N-S	br-blk-blk-br-br
☐	R16	22.1 k 1/4W 1% (top)	N-S	r-r-brn-r-br
☐	R17	475 1/4W 1% (top)	E-W	y-v-grn-bl-br

Install Ceramic Capacitors

See Band-specific Capacitors chart for value.

See hints on identifying and installing Ceramic Capacitors.



Check	Designation	Component (top/bottom)	Orientation	Marking	Ima
☐	C12	22 pF 5% (top)		22J	
☐	C10	180 pF 5% (top)		181	
☐	C11	100 pF 5% (top)		101	

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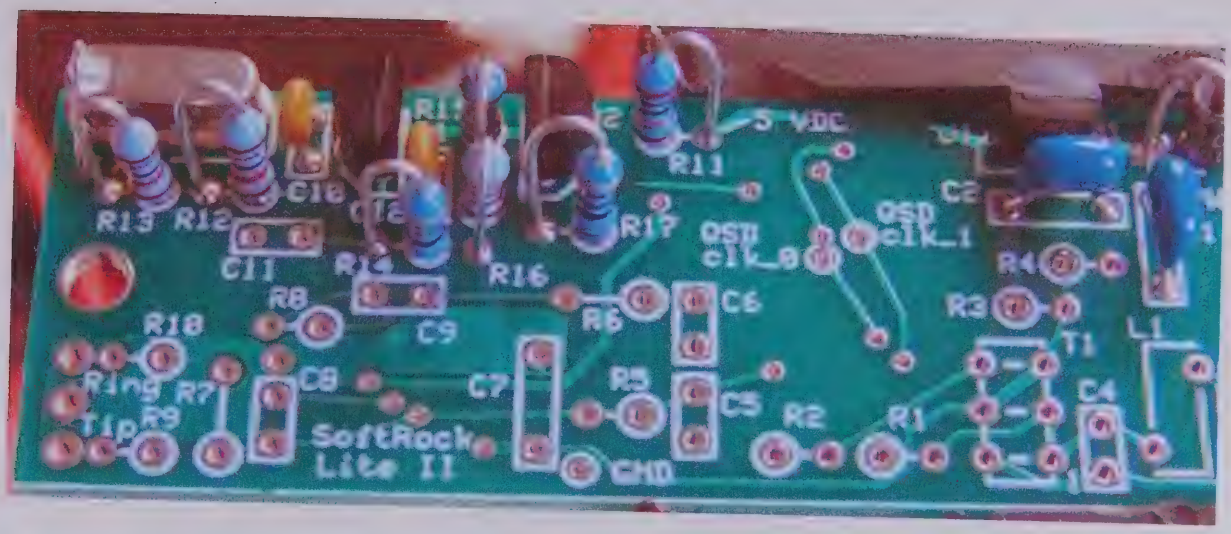
Completed Photos

Note: the completed pictures are of the 40m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside



View of Completed Underside

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Testing

Overview

Visual Check

Test Setup

Using very good lighting and magnification,

carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Current Draw

Test Setup

- connect a 1k ohm resistor in series with the positive power lead
- apply 12 Vdc and measure the current draw with the limiting resistor in place
- remove the current limiting resistor
- apply 12 Vdc and measure the current draw without the limiting resistor

(measurements courtesy of Leonard KC0WOX)

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
With the 1k limiting resistor	mA	< 9	7.3	_____
Without current limiting resistor	mA	< 20	14.1	_____

Voltage Tests

Test Setup

- Power the board
- Measure the testpoint voltages with respect to ground

Note that some of the voltages measured may have ac components, which, depending upon your DMM, may average in with the dc voltages to produce higher apparent dc voltages than theory would suggest.

Author measured the dc voltage at R17 using a scope and got ~2.6 Vdc. Per Alan, G4ZFQ, This voltage (at R17) is not critical and can vary a lot, partly depending on the crystal. The important thing is that the LO's RF output is a good healthy signal and is detectable on an external RX (or counter or scope).

Test Measurements

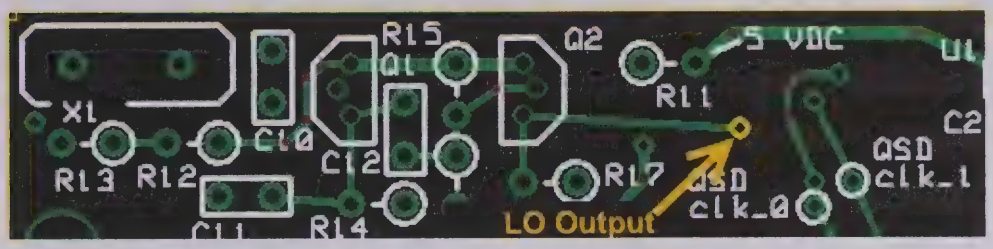
Testpoint	Units	Nominal Value	Author's	Yours
R11 hairpin	Vdc	4.5 - 5	4.9	_____
R15 hairpin	Vdc	< R11 hairpin	4.7	_____
R12 hairpin	Vdc	< 2.5	2.3	_____
R17 hairpin	Vdc	> 2.0	4.2	_____

LO Output Test

Test Setup

- You can use a ham receiver tuned to the appropriate crystal frequency. You should hear the LO's frequency.
- Scope measurements may be taken IF you have a high quality, calibrated scope with correctly compensated probes
- Note: 1/3 sub-harmonic sampling does

reverse the spectrum. Changing the audio cable connections to the SoftRock Lite circuit board from tip to ring and ring to tip will correct the reversed spectrum so that the SDR software works the same for the higher band receivers as with the lower band receivers. (See Cecil K5NWA'a explanation of the sub-harmonic sampling in his message on the Yahoo Softrock group.

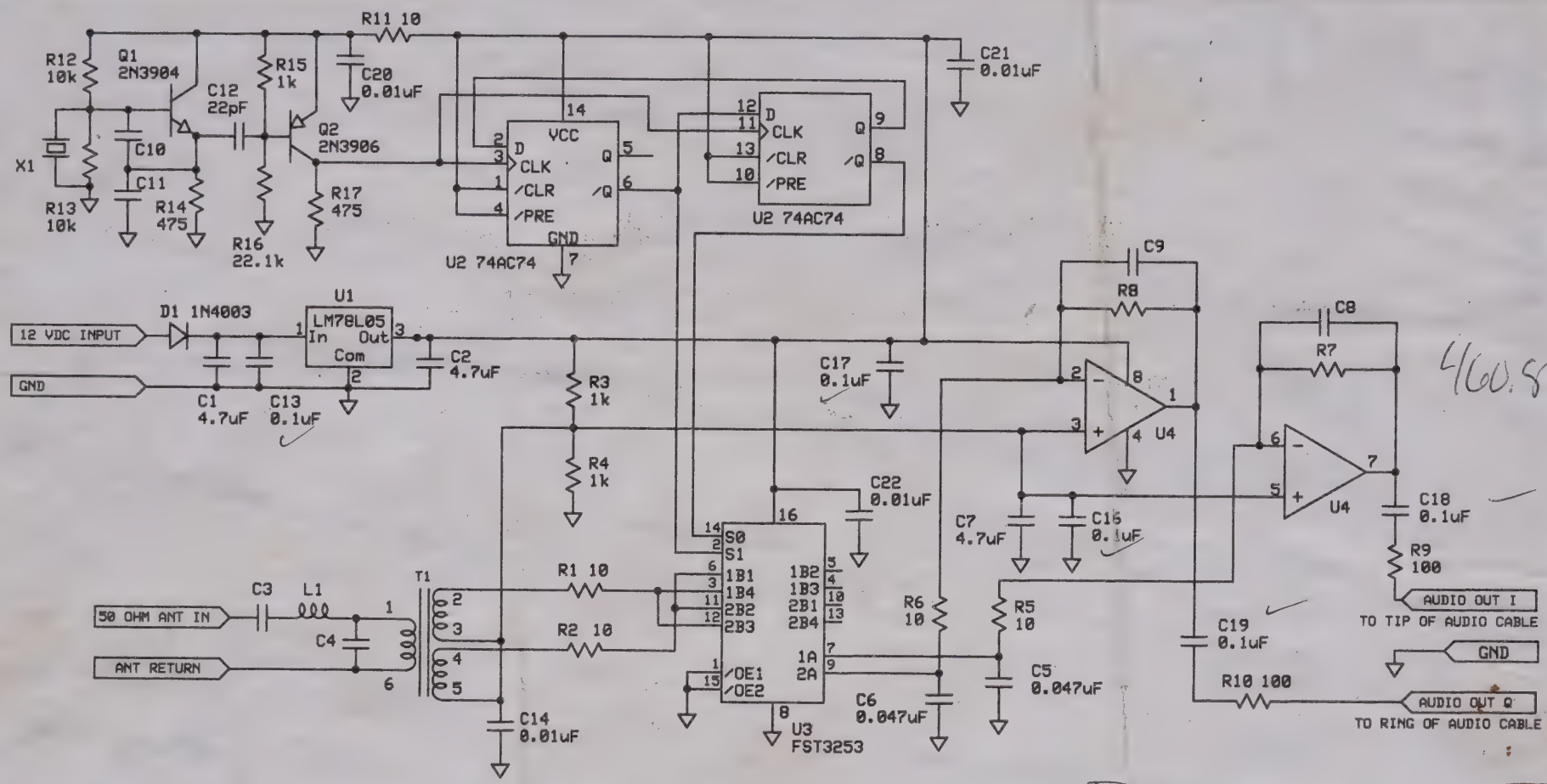


Test Measurements

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1 □	"Lo Output" testpoint	MHz	18.73	18.73	_____

Go to Top of Page

Next Stage: Divider



460.8 kfs

Band specific component values

Component	160m	80m	40m	Upgraded 30m	Upgraded 20m	Upgraded 15m
X1 frequency	7.3728 MHz	14.06 MHz	28.224 MHz	13.5 MHz	18.73 MHz	28.06 MHz
Op-Amp U4	TLV2462	TLV2462	TLV2462	LT6231	LT6231	LT6231
C10	330 pF	180 pF	100 pF	180 pF	180 pF	100 pF
C11	180 pF	100 pF	not used	100 pF	100 pF	not used
C8/C9	1500 pF	1500 pF	1500 pF	220 pF	220 pF	220 pF
R7/R8	1.00 k	1.00 k	1.00 k	4.99 k	4.99 k	4.99 k
C3	390 pF	220 pF	100 pF	68 pF	47 pF	56 pF
C4	5600 pF	3300 pF	1500 pF	1000 pF	680 pF	390 pF
L1	19.6 uH	9.1 uH	5.0 uH	3.5 uH	2.5 uH	1.0 uH
	T30-2 core	T30-2 core	T25-2 core	T25-6 core	T25-6 core	T25-6 core
	67T,#30	46T,#30	38T,#30	36T,#30	30T,#30	19T,#30
T1 primary	1.4 uH	0.73 uH	0.35 uH	0.28 uH	0.18 uH	0.18 uH
	T30-2 core	T30-2 core	T25-2 core	T25-6 core	T25-6 core	T25-6 core
	18T,#30	13T,#30	10T,#30	10T,#30	8T,#30	8T,#30
T1 secondaries	bifilar,	bifilar,	bifilar,	bifilar,	bifilar,	bifilar,
	8T, #30	6T, #30	5T, #30	5T, #30	4T, #30	4T, #30

TO92 LM78L05
" 2N3904
" 2N3906
SOIC14 74AC74
SOIC16 FST3253
SOIC8 LT6231

SoftRock Projects		
SoftRock Lite II		
Tony KB9YIG	12/22/08	Page 1 of 3

no clean organic flux

63/37

0.015"

Sulberwick .025"

SPC

750° heat

www.leedinsurance.com/dental

SoftRock Lite II for 455 kHz IF use

2/21/09

C10 1000pF
C11 1000pF
C12 180pF

L1 38T of #30 on FT37-61 core (79uH)

T1 31T of #30 on primary and 17T of #30 on each of the two secondary bifilar windings over the top of the primary on a T30-2 core (4.1uH on primary).

Red

C3 1500pF
C4 0.033uF

Crystal X1 is 1.843 MHz for a QSD clock frequency at about 460kHz.

÷4

4T = 1 1/2"

4 | 38 15"
10

no clean organic flux

63/37

0.015

Sulderwick .02 std

SPC

750

www.'

SoftRock Lite II for 455 kHz IF use

7/8/09

L.O. changes for i.f. converter yields 460 kHz down conv. freq

C10 1000pF
C11 1000pF
C12 180pF

R16 10k

vel T 30-2 36T 79uH

L1 38T of #30 on FT37-61 core (79uH) (148T on 30-6)
correct 0.2-10 mHz

T1 31T of #30 on primary and 17T of #30 on each of the two secondary bifilar windings over the top of the primary on a T30-2 core (4.1uH on primary). (34T on 30-6 pri)

$\frac{34}{31}$ 17 = 19T sec

C3 1500pF
C4 0.033uF

Crystal X1 is 1.843 MHz for a QSD clock frequency at about 460kHz.

and

2N3904
2N3906

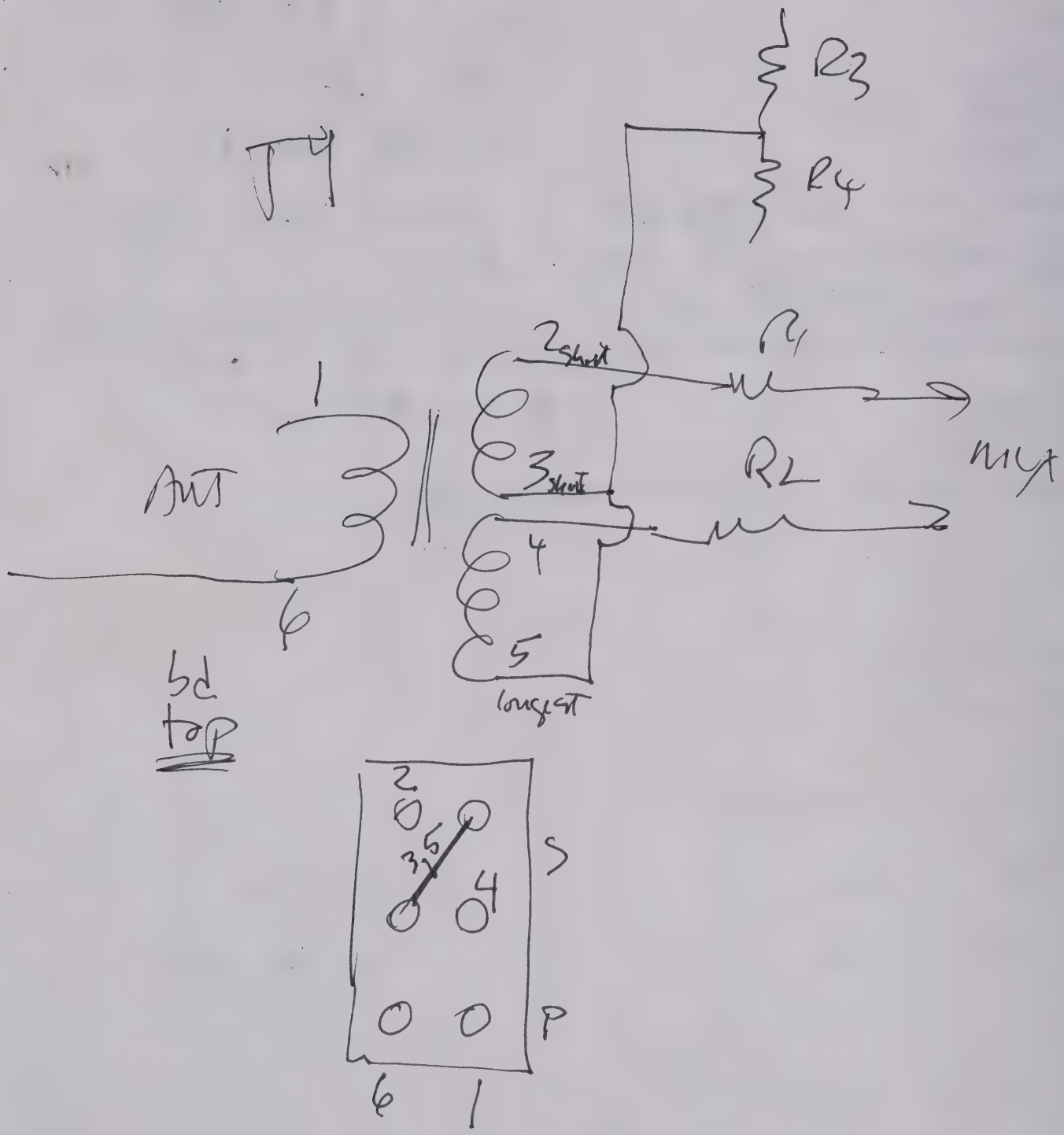
2 - 475 Ω

2 - 10K

1 - 1K

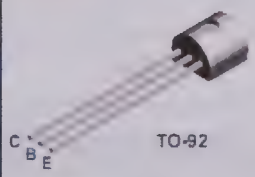
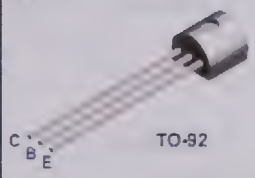
T 30-6
3-40 mHz

kits and parts.com/trimcs


R3
R4
2 short
R1
1
3 short
R2
MIX
ANT
4
6
5
longest
bd
top
2
5
3
4
S
P
6
1

Local Oscillator Bill of Materials

Detailed Bill of Materials

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C10	band-specific		misc			Local Oscillator
❑	C11	band-specific		misc		Not used at all for 40m & 15m versions	Local Oscillator
❑	C12	22 pF 5%	22J	Ceramic			Local Oscillator
❑	C20	0.01 uF		SMT 1206			Local Oscillator
❑	Q1	2N3904 NPN Transistor	2N3904 	TO-92			Local Oscillator
❑	Q2	2N3906 PNP transistor	2N3906 	TO-92			Local Oscillator
❑	R11	10 ohm 1/4W 1%	br-blk-blk-gld-br	1/4W	W-E		Local Oscillator
❑	R12	10 k 1/4W 1%	br-blk-blk-r-br	1/4W	E-W		Local Oscillator
❑	R13	10 k 1/4W 1%	br-blk-blk-r-br	1/4W	E-W		Local Oscillator
❑	R14	475 1/4W 1%	y-v-grn-bl-br	1/4W	E-W		Local Oscillator
❑	R15	1 k 1/4W 1%	br-blk-blk-br-br	1/4W	N-S		Local Oscillator
❑	R16	22.1k 1/4W 1%	r-r-brn-r-br	1/4W	N-S		Local Oscillator
❑	R17	475 1/4W 1%	y-v-grn-bl-br	1/4W	E-W		Local Oscillator
❑	X1	band-specific		misc			Local Oscillator

Band Specific Items for 160m Band

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C10	330 pF 5%	331	Ceramic			Local Oscillator

❑	C11	180 pF 5%	181	Ceramic		Not used at all for 40m & 15m versions	Local Oscillator
❑	X1	7.3728 MHz		Xtal			Local Oscillator

Band Specific Items for 80m Band

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C10	180 pF 5%	181	Ceramic			Local Oscillator
❑	C11	100 pF 5%	101	Ceramic		Not used at all for 40m & 15m versions	Local Oscillator
❑	X1	14.06 MHz		Xtal			Local Oscillator

Band Specific Items for 40m Band

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C10	100 pF 5%	101	Ceramic			Local Oscillator
❑	C11	unused capacitor		unused		Not used at all for 40m & 15m versions	Local Oscillator
❑	X1	28.224 MHz Crystal	28.224 or 28.2C69	Xtal			Local Oscillator

Band Specific Items for 30m Band

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C10	180 pF 5%	181	Ceramic			Local Oscillator
❑	C11	100 pF 5%	101	Ceramic		Not used at all for 40m & 15m versions	Local Oscillator
❑	X1	13.5 MHz		Xtal			Local Oscillator

Band Specific Items for 20m Band

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C10	180 pF 5%	181	Ceramic			Local Oscillator

❑	C11	100 pF 5%	101	Ceramic		Not used at all for 40m & 15m versions	Local Oscillator
❑	X1	18.73 MHz	18.730 1108	Xtal			Local Oscillator

Band Specific Items for 15m Band

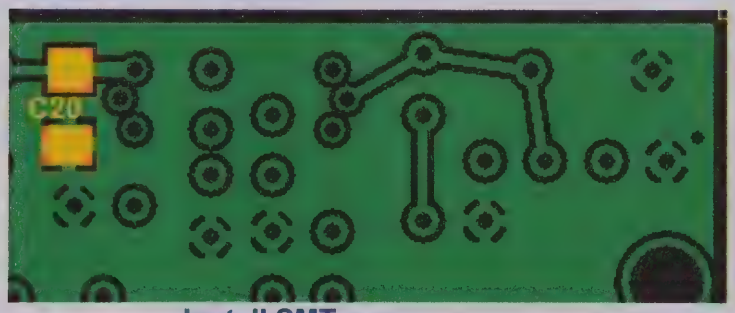
Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C10	100 pF 5%	101	Ceramic			Local Oscillator
❑	C11	unused capacitor		unused		Not used at all for 40m & 15m versions	Local Oscillator
❑	X1	28.06 MHz		Xtal			Local Oscillator

Local Oscillator Summary Build Notes

- Install SMT cap
- Install Crystal
- Install Ceramic Capacitors
- Install transistors
- Install Resistors
- Test the Stage

Local Oscillator Detailed Build Notes

Bottom of the Board



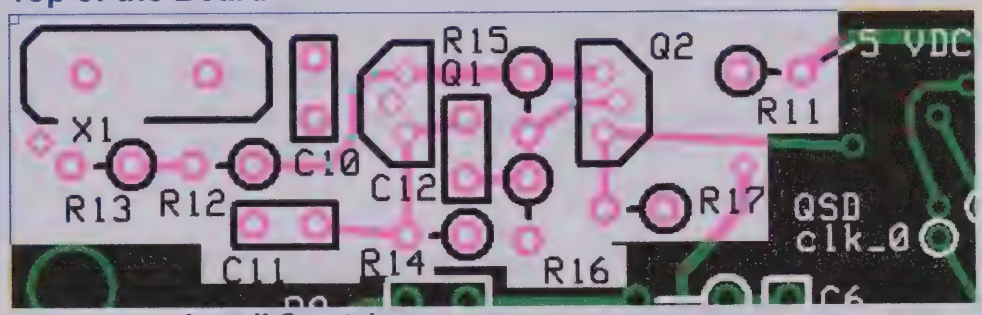
Install SMT cap

See hints on installing SMT Caps.

Install SMT cap photo

Check	Designation	Component	Marking	Category	Orientation	Notes
❑	**C20**	**0.01 uF**		**SMT 1206**		

Top of the Board

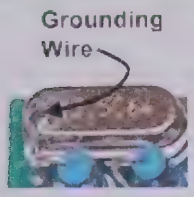


Install Crystal

See Band-specific Components chart for value.

Mount the HC49 crystal mounting in the upper left corner of the board, mounting it vertically to the board. A small plated-through hole in the lower left corner of the crystal mounting position provides a place for a grounding wire to be soldered to the metal crystal case. The grounding wire also provides additional mechanical support for the crystal.

Make sure the crystal is mounted slightly above the board. You can use a piece of cardboard or wire insulation between the bottom of the crystal and the board to get the desired standoff distance while mounting X1.

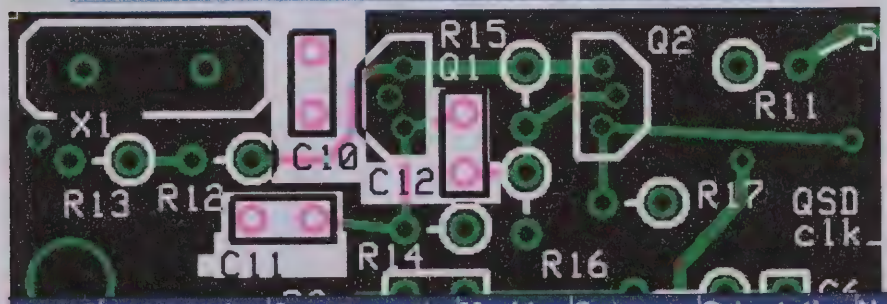


Check	Designation	Component	Marking	Category	Orientation	Notes
❑	X1	band-specific		misc		

Install Ceramic Capacitors

See Band-specific Capacitors chart for value.

See hints on identifying and installing Ceramic Capacitors.



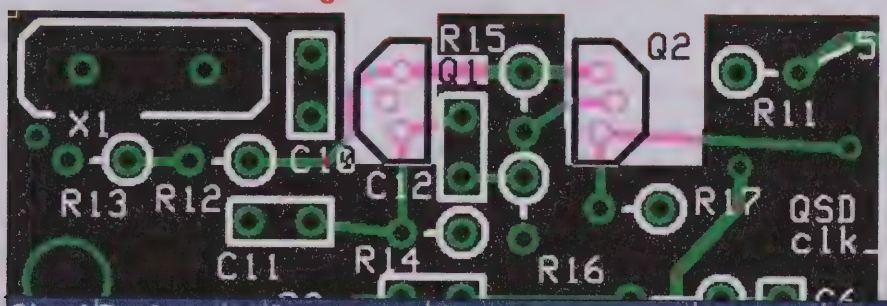
Check	Designation	Component	Marking	Category	Orientation	Notes
❑	C12	22 pF 5%	22J	Ceramic		
❑	C10	band-specific		misc		
❑	C11	band-specific		misc		Not used at all for 40m &

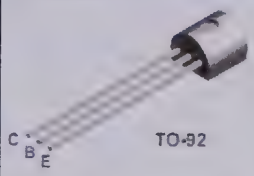
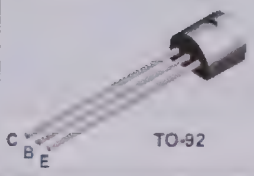
						15m versions

Install transistors

Mount the two transistors being careful to orient them according to the pattern in the silkscreen.

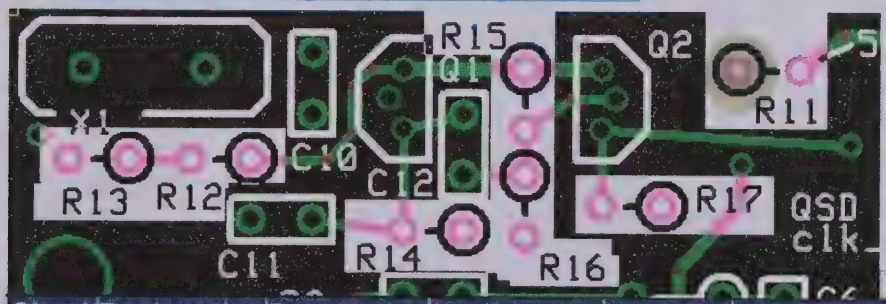
Take care not to get 2N3904 and 2N3906 mixed up. Carefully check the last digit.



Check	Designation	Component	Marking	Category	Orientation	Notes
❑	Q1	2N3904 NPN Transistor	2N3904 	TO-92		
❑	Q2	2N3906 PNP transistor	2N3906 	TO-92		

Install Resistors

See hints on installing and orienting resistors

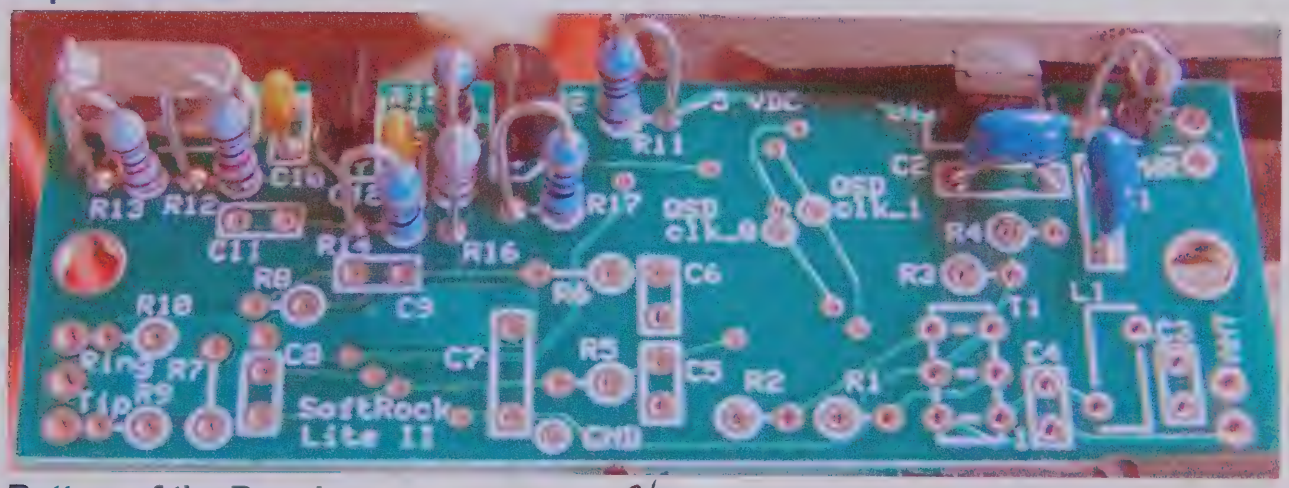


Check	Designation	Component	Marking	Category	Orientation	Notes
❑	R17	475 1/4W 1%	y-v-grn-bl-br	1/4W	E-W	
❑	R16	22.1k 1/4W 1%	r-r-brn-r-br	1/4W	N-S	
❑	R15	1 k 1/4W 1%	br-blk-blk-br-br	1/4W	N-S	

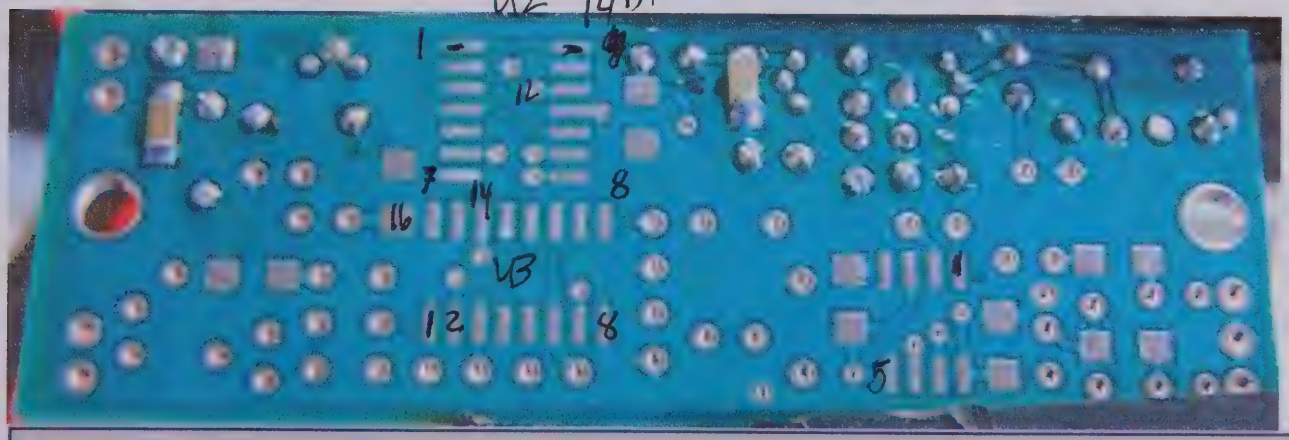
❑	R14	475 1/4W 1%	y-v-grn-bl-br	1/4W	E-W	
❑	R13	10 k 1/4W 1%	br-blk-blk-r-br	1/4W	E-W	
❑	R12	10 k 1/4W 1%	br-blk-blk-r-br	1/4W	E-W	
❑	R11	10 ohm 1/4W 1%	br-blk-blk-gld-br	1/4W	W-E	

Local Oscillator Completed Stage

Top of the Board



Bottom of the Board



Local Oscillator Testing

Visual Check

Test Setup

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Current Draw

AC 3-13 11/5/13
L.O. update

MHz fundamental frequency and first harmonmic, but allows 20m signals centering around the third harmonic (14.0475) of the 4.6825 MHz LO output.

- The result is that the mixer is dealing with signals in the passband, centering on 14.0475 MHz, as though the dividers were passing a fundamental frequency of 14.0475 to the mixer. BPFs are all that stop Softrocks from working on unwanted frequencies!

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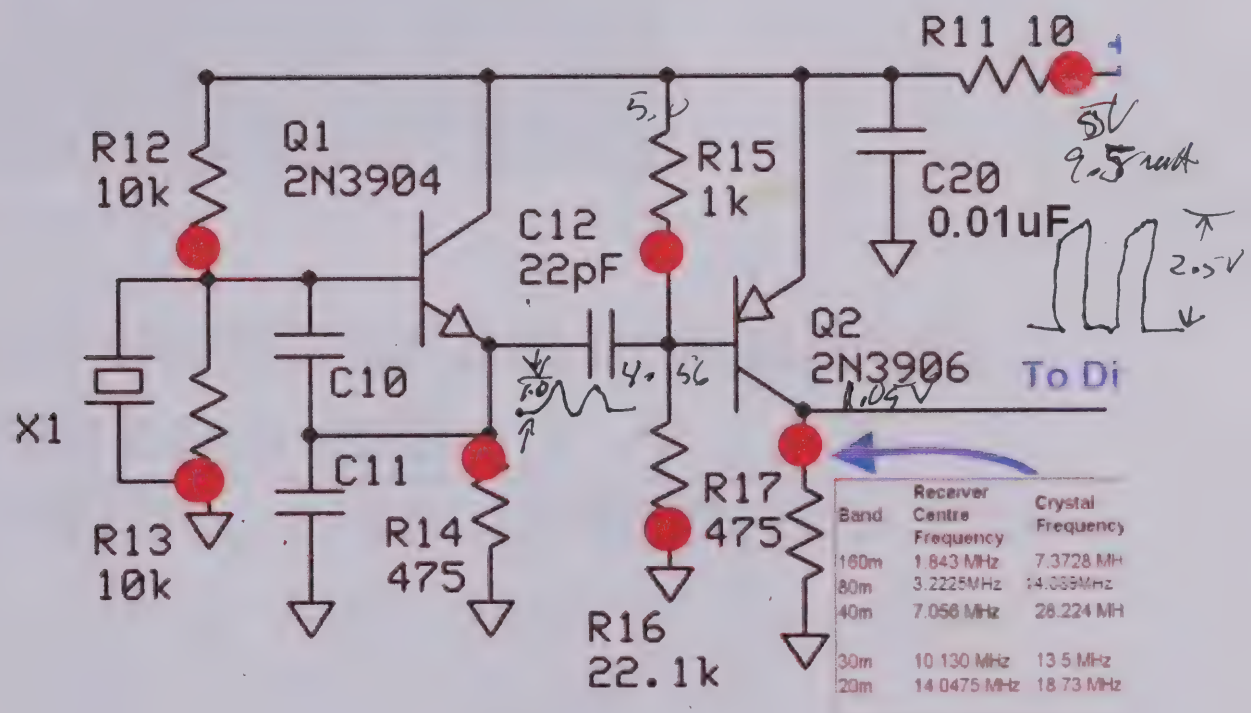
Stage Schematic



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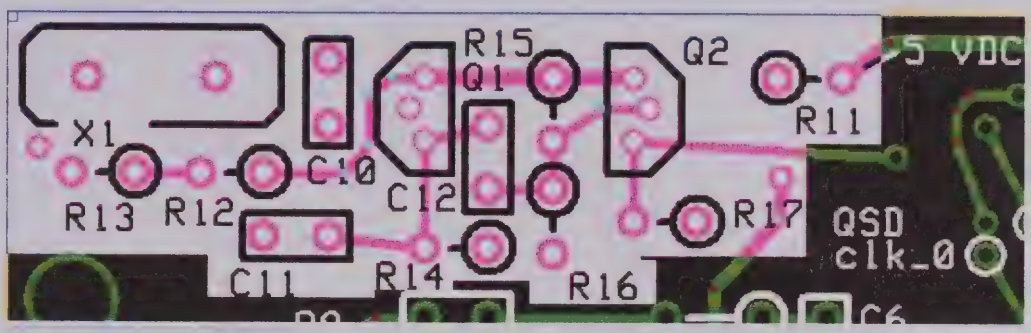
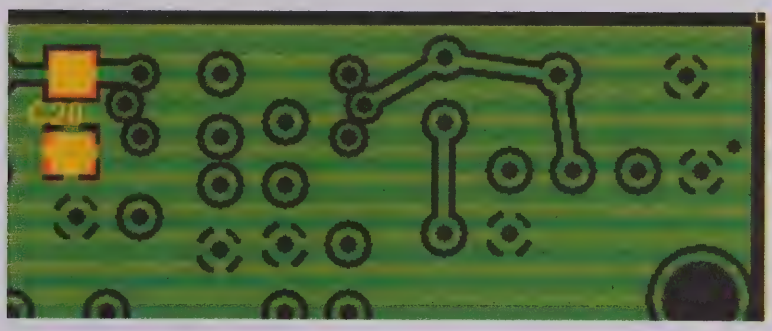
Board Layouts

Board Top



Go to Top of Page

Board Bottom



Go to Top of Page

Local Oscillator Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking
☐	Capacitor	Ceramic	22 pF 5%	1	22J
☐	Capacitor	Ceramic	100 pF 5%	1	101
☐	Capacitor	Ceramic	180 pF 5%	1	181

The Cat's Eye Nebula. Credit: NASA, ESA, HEIC and The Hubble Heritage Team (STScI/AURA)

ultraviolet light. The ACS also has a coronagraph that blocks out the glare of bright objects so astronomers can study fainter objects in the same vicinity. A single ACS image is 4096 x 4096 pixels — compare that to HDTV at 1920 x 1080. Then consider that STScI had to create mosaics made up of 16 such images and you'll get an idea of what they were dealing with.

STScI senior video animator Greg Bacon recalls: "When the first ACS high-resolution images arrived, we wondered how we were going to display them. A single ACS image contains an IMAX-screen worth of pixels and we had plans to produce some truly immense images by making mosaics of several ACS images."

Next Page: *Seeing What the Hubble Sees*

Mars. Credit: Phil James (Univ. Toledo), Todd Clancy (Space Science Inst., Boulder, CO), Steve Lee (Univ. Colorado) and NASA

☐	Capacitor	SMT 1206	0.01 uF	1	(smt) no stripe
☐	Resistor	1/4W	10 ohm 1/4W 1%	1	br-blk-blk-gld-br
☐	Resistor	1/4W	475 1/4W 1%	2	y-v-grn-bl-br
☐	Resistor	1/4W	1 k 1/4W 1%	1	br-blk-blk-br-br
☐	Resistor	1/4W	10 k 1/4W 1%	2	br-blk-blk-r-br
☐	Resistor	1/4W	22.1 k 1/4W 1%	1	r-r-brn-r-br
☐	Transistor	TO-92	2N3904 NPN Transistor	1	2N3904
☐	Transistor	TO-92	2N3906 PNP transistor	1	2N3906
☐	Xtal	Xtal	18.73 MHz	1	18.730 1108

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Detailed Build Steps

Install SMT cap

Badgerland German Shepherd Rescue, Inc, you are agreeing to forever, release, discharge, hold harmless and indemnify: any and all entities, corporations, and persons that are associated in any manner with Badgerland German Shepherd Rescue, Inc, the information, or the dogs; charged or chargeable with responsibility or liability, which includes but is not limited to: Badgerland German Shepherd Rescue, Inc and its Board of Directors, Rescue Volunteers, etc. including their heirs, administrators, executors, successors and assigns; from any and all claims, damages, costs, expenses, loss of services, actions and causes of action belonging to you and any other persons, corporations, or entities, arising out of viewing, using, or acting upon said information, which includes but is not limited to: any and all injuries, damages, or claims resulting from placing, obtaining or maintaining a dog or dogs.

Applicant Signature: _____
Date: _____

Co-Applicant Signature: _____
Date: _____

See hints on installing SMT Caps.

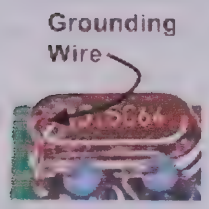
Check	Designation	Component (top/bottom)	Orientation	Marking	Ima
☐	C20	0.01 uF ((bottom))	yellow pads	(smt) no stripe	

Install Crystal

See Band-specific Components chart for value.

Mount the HC49 crystal mounting in the upper left corner of the board, mounting it vertically to the board. A small plated-through hole in the lower left corner of the crystal mounting position provides a place for a grounding wire to be soldered to the metal crystal case. The grounding wire also provides additional mechanical support for the crystal.

Make sure the crystal is mounted slightly above the board. You can use a piece of cardboard or wire insulation between the bottom of the crystal and the board to get the desired standoff distance while mounting X1.



Check	Designation	Component (top/bottom)	Orientation	Marking	Ima

Are you willing to accept that the dog may not like all of your childrenÍs friends? Yes No
If your GSD doesnÍt like one of your childrenÍs friends, what will you do?

Adoption Responsibilities:

Do you agree to return the GSD to BGSR in the event that you are no longer able to keep the dog? Yes No
Do you agree to contact BGSR if you are considering euthanizing the GSD for non-terminal health or physical suffering reasons? Yes No
Are you willing to allow a BGSR member to visit your home? Yes No If no, why:

Do you agree to contact a BGSR member if your new GSD is having difficulty (behavioral problems, etc) adjusting to your home? Yes No If no, why:

Adoption Fees:

Our Adoption Fees are subject to change and you should check with a BGSR Volunteer to verify the adoption fee of the particular dog you are interested in adopting.

One year and under Ü $200.00
Exceptional Pedigree or Papers - $200.00
1-7 years - $175.00
Over 7 years - $125.00

*An additional fee will be added to the Adoption Fee to ensure completion of required obedience classes and spaying or neutering (if necessary). The additional fee(s) will be reimbursed upon receipt of obedience and/or spay/neuter certificate.

Thank you for taking the time to complete this questionnaire. Your answers will permit us to more effectively match your needs with GSDÍs in our program.

DISCLAIMER OF WARRANTIES

By submitting this Adoption Application I authorize my veterinarian and personal references to release any information requested by BGSR and/or its representatives at any time it is requested.

We reserve the right to refuse or deny any application. By submitting this form, you attest that all the information contained in the application is complete and truthful. In addition, you expressly authorize Badgerland German Shepherd Rescue, Inc to verify the information on this Adoption Questionnaire form. Any misrepresentation will constitute grounds for automatic rejection.

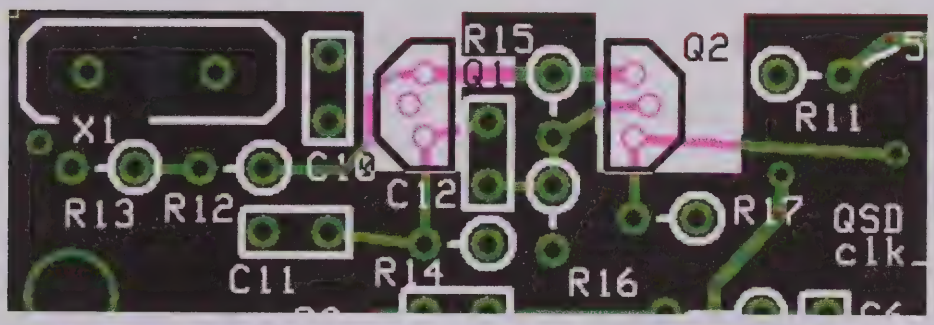
By submitting this form or acting upon any information provided by

☐	X1	18.73 MHz (top)		18.730 1108	

Install transistors

Mount the two transistors being careful to orient them according to the pattern in the silkscreen.

Take care not to get 2N3904 and 2N3906 mixed up. Carefully check the last digit.



Check	Designation	Component (top/bottom)	Orientation	Marking	Ima
☐	Q1	2N3904 NPN Transistor (top)		2N3904	C B E
☐	Q2	2N3906 PNP transistor (top)		2N3906	C B E

Residence Information:

House Condo Apartment Mobile Home

Do you? Own Residence
*Rent Residence

Approximate size of yard?
_____

Do you have a pool? Yes No
If yes, is the pool secured? Yes No

Is your yard fenced? Yes No
If yes, what type of fence?
Chain Link Privacy
Invisible Other Fence Height
_____Feet

If you do not have a fenced yard, please describe how you will safely handle exercise and potty breaks:

Do you have an outside dog run or kennel? Yes No
If yes, is there access to the house or garage? Yes No
If no, what shelter is available?
_____

Do children or strangers have access to your yard?
Yes No

Are there any outside distractions (check all that apply)?
Neighboring dogs or cats
Loose dogs or cats
Children Busy street

Have you checked your home/yard for dangerous objects, plants, or chemicals? Yes No

Are you willing to make improvements to your home or yard in order to provide a safe and secure environment for you dog?
Yes No

***If you rent, provide LandlordÍs name:**
_____ **& Phone Number**
_____

You must send a copy of your lease with this application.

The Adopted GSD:

Who is the GSD for?

Who will be the primary caretaker of the dog?

Have all household members discussed the pros & cons of owning a GSD? Yes No
Does everyone in the household want a GSD? Yes No
If no, who in the household objects and why?

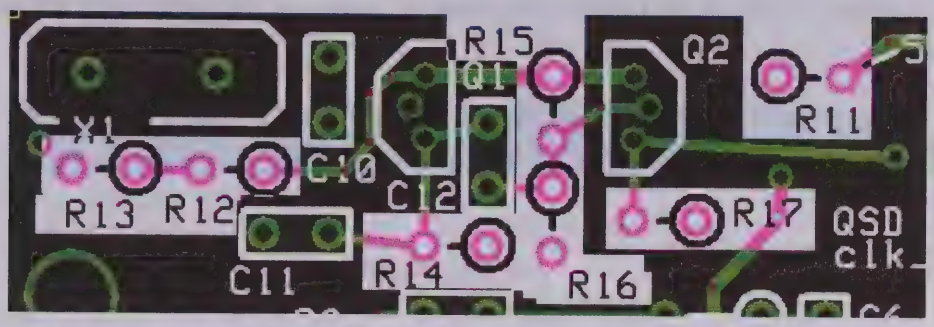
How many hours per day will your GSD be unattended? 0-4 hours 4-8 hours 8-12 hours More than 12 hours
If your GSD will be unattended for extended periods of time, do you have arrangements in place to allow the dog out?
Yes No If yes, please describe arrangements:

Where will the dog be kept while unattended? Crated, inside house Uncrated, free roam of house Basement
Garage Outdoor kennel run Tied out in yard Loose, outdoors
Other:_____
Where will the dog be kept when people are home? Inside Outside

Where will the dog sleep at night? Crated, inside house Uncrated, free roam of house Basement Garage
Outdoor kennel run Tied out in yard Loose, outdoors

Install Resistors

See hints on installing and orienting resistors



Check	Designation	Component (top/bottom)	Orientation	Marking
☐	R11	10 ohm 1/4W 1% (top)	W-E	br-blk-blk-gld-br
☐	R12	10 k 1/4W 1% (top)	E-W	br-blk-blk-r-br
☐	R13	10 k 1/4W 1% (top)	E-W	br-blk-blk-r-br
☐	R14	475 1/4W 1% (top)	E-W	y-v-grn-bl-br
☐	R15	1 k 1/4W 1% (top)	N-S	br-blk-blk-br-br
☐	R16	22.1 k 1/4W 1% (top)	N-S	r-r-brn-r-br
☐	R17	475 1/4W 1% (top)	E-W	y-v-grn-bl-br

Install Ceramic Capacitors

See Band-specific Capacitors chart for value.

See hints on identifying and installing Ceramic Capacitors.

Other:_____

How much do you anticipate spending per year to feed, vaccinate, license, & provide medical care for your new GSD?

$ _____

Where & How will you exercise your GSD?

Will you use a leash to walk your GSD? Yes No

Behavior & Training:

In addition to the required obedience classes, how much time & effort do you plan to devote to training your new GSD? Please be specific:

What is your definition of disciplining a dog?

What would be your response when your new GSD makes a mistake?

Have you considered how to prevent or correct behavior problems such as Barking, Housebreaking, Chewing, Digging, or Aggression? Yes No Please explain how you would deal with these types of behavior:

It may take your new GSD a month or longer to adjust to its new home. During that adjustment period, some undesirable behaviors may emerge such as, housebreaking issues, intestinal distress, pacing, etc. Are you prepared/willing to work through the adjustment period with a new GSD? Yes No If no, why not?

General Information:

Does you lifestyle allow for the time and energy needed to properly care for and train a GSD? Yes No

Please explain:

Is your lifestyle such that friends, relatives, and/or children may gain admittance to your home or property without your supervision? Yes No If yes, please elaborate:

German Shepherds may live longer than 10 years. Are you ready to take responsibility for the dogÍs entire lifetime?

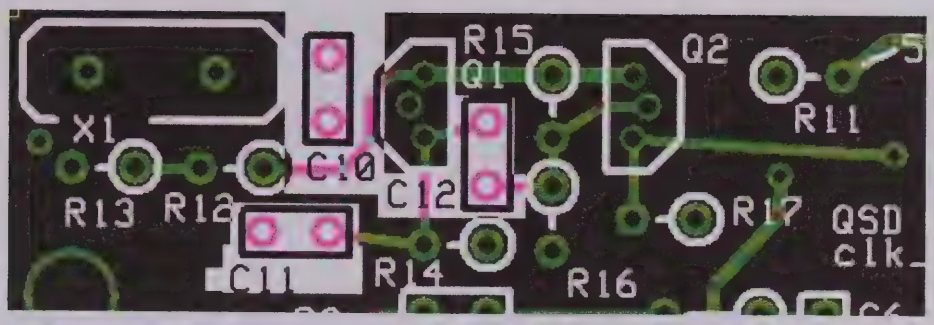
Yes No If no, why not?

How would a significant change in lifestyle (i.e. birth of a child, significant family illness, moving, change of employment, divorce) affect the dog?

If you have children or children who visit on a regular basis, please complete the following questions. If not, move on to next section.

Are you willing to accept the additional responsibility of owning a GSD. This may include ñchildproofingî your dog & additional training sessions with the children and dog, etc? Yes No

Are you willing to teach the children the proper way to handle live animals, especially a large breed dog? Yes No



Check	Designation	Component (top/bottom)	Orientation	Marking	Ima
☐	C12	22 pF 5% (top) 180 for if		22J	
☐	C10	180 pF 5% (top) 1000 for if		181	
☐	C11	100 pF 5% (top) 1000 for if		101	

Go to Top of Page

Completed Photos

Note: the completed pictures are of the 40m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside

Yes No

Yes No

Yes No

Yes No

Where did your previous pets stay while unattended? In house, crated/confined In house, free roam of the house
Garage Basement Outdoors

Have you ever had any complaints about your pets? Yes No If, yes, please elaborate:

Have you ever applied to adopt or adopted a pet from a Humane Society or Rescue Group? Yes No
If yes, how long ago? _____
If yes, please provide name of Humane Society or Rescue Group:
_____

Are you currently working with another rescue group or Humane Society to find a GSD? Yes No
*If yes, please provide the name of the rescue or Humane Society
_____

***This will not exclude you from working with BGSR.**

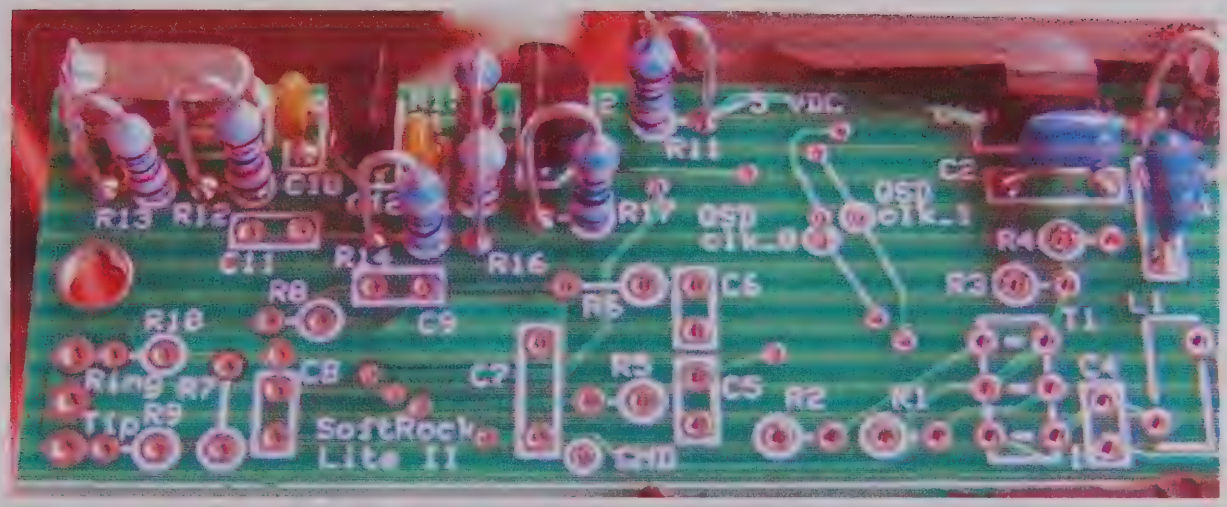
Veterinary Information: Please list any Veterinarian(s) you have used within the past 5 years

Clinic Name	VeterinarianÍs Name	Address including City & State	Phone number w/area code

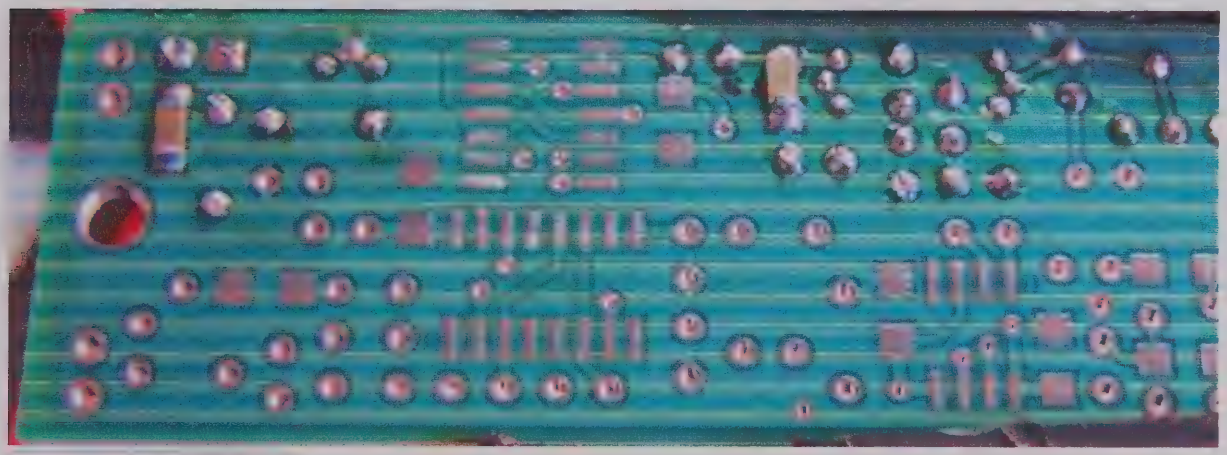
You must contact your veterinarian to authorize the release of records/information regarding your pets to BGSR.
Failure to do so may significantly delay the processing of your application.

Personal References: Please provide at least two personal references. One reference must be a NON-RELATIVE.

Name	Relationship	Address, including city & state	Phone # w/area code	E-Mail Address



View of Completed Underside



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Testing

Overview

Visual Check

Test Setup

Using very good lighting and magnification,

bunch, is irrelevant. The SWM is not, however, a suitable technique to measure the beam impedance for frequencies where a strong electric field on axis exists in the open beampipe (i.e., $E_z(r\approx 0,z,\omega)\neq 0$). A rough estimate of the beam impedance may be found for these frequency regimes through a manipulation of data from stretched wire measurements by use of both high-impedance and low-impedance reference lines.

The integral equation of Eq. 1-12 describes the solution to the electric and magnetic field distributions for the wire and charged particle beam excitations. Using the complex Fourier series analysis presented in this dissertation solves Eq. 1-12 and correctly estimates the measured beam and circuit impedances. This general use of complex Fourier series analysis allows one to find circuit models for different cavity and beampipe geometries.

When it is assumed that there are no losses in the system, i.e., perfectly conducting boundaries, the calculated data for the beam impedance has to be modified slightly for frequencies below the first cutoff frequency of the open beampipe. This modification technique was pointed out in Ch. IV.C.ii in Figs. 4-3 and 4-4. The adjustment was performed using a comparison to two simple coupling circuit models over a narrow bandwidth about the resonant frequency of the cavity. One circuit model had loss whereas the other was lossless. The propagating modes of the beampipe add an

carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Current Draw

Test Setup

- connect a 1k ohm resistor in series with the positive power lead
- apply 12 Vdc and measure the current draw with the limiting resistor in place
- remove the current limiting resistor
- apply 12 Vdc and measure the current draw without the limiting resistor

(measurements courtesy of Leonard KC0WOX)

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
With the 1k limiting resistor	mA	< 9	7.3	_____
Without current limiting resistor	mA	< 20	14.1	8.5

~~[illegible]~~ 3V

signal ON R17

Voltage Tests

Test Setup

- Power the board
- Measure the testpoint voltages with respect to ground

impedance. The SWM requires the use of a commercially available network analyzer or pulsing network. Stretched wire measurements are performed by first placing a wire upon the designed trajectory of a charged particle bunch. After the wire is in place, an impulse of current is excited on the wire and its network parameters are measured. The lumped circuit impedance measured by the network analyzer is hypothesized to be equal to the longitudinal beam impedance.

Clearly, the addition of a wire inside the beampipe changes the boundary conditions inside the accelerator. Placement of a wire along the trajectory of the charged particle bunch changes the boundary conditions of the system such that the wakefield at this position identically vanishes. The effectiveness of the SWM technique, however, relies upon energy storage in the discontinuity region of the beampipe.

The SWM technique was proposed as a simple measurement for finding the effects of the environment on charged particle beams. In this dissertation the SWM was shown to provide excellent results for frequencies where the field intensities are similar between the open beampipe and the boundary conditions dictated by the center conductor beampipe (i.e., $E_z(r\approx 0,z,\omega)\approx 0$). For frequencies where $E_z(r\approx 0,z,\omega)\approx 0$, the method of excitation, whether it is an impulse of current excited on a wire or an ultra-relativistic charged particle

Note that some of the voltages measured may have ac components, which, depending upon your DMM, may average in with the dc voltages to produce higher apparent dc voltages than theory would suggest.

Author measured the dc voltage at R17 using a scope and got ~2.6 Vdc. Per Alan, G4ZFQ, This voltage (at R17) is not critical and can vary a lot, partly depending on the crystal. The important thing is that the LO's RF output is a good healthy signal and is detectable on an external RX (or counter or scope).

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
R11 hairpin	Vdc	4.5 - 5	4.9	_____
R15 hairpin	Vdc	< R11 hairpin	4.7	_____
R12 hairpin	Vdc	< 2.5	2.3	_____
R17 hairpin	Vdc	> 2.0	4.2	_____

LO Output Test

Test Setup

- You can use a ham receiver tuned to the appropriate crystal frequency. You should hear the LO's frequency.
- Scope measurements may be taken IF you have a high quality, calibrated scope with correctly compensated probes
- Note: 1/3 sub-harmonic sampling does

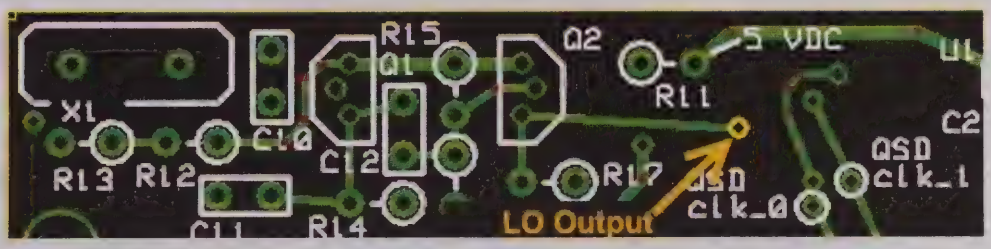
VI. Summary and Conclusions

The design of a stable accelerator requires an understanding of the interaction between a charged bunch and its environment. The longitudinal beam impedance is a measure of the electric field, caused by an ultra-relativistic impulse of charge, along the trajectory of the ultra-relativistic charge. This interaction between an ultra-relativistic charge and its environment produces electromagnetic fields which are defined as the wakefield. The presence of the wakefield is a particular problem faced by accelerator scientists. By design, the interaction of charged particle beams with their environment is both constructive and destructive to the operation of accelerators.

Wakefield accelerator machines have been built which directly measure the beam impedance. These machines have several problems inherent to the machine. These machines are very expensive and furthermore, for a variety of reasons, measurements on these machines are costly. The machine is not portable and has very specific geometry requirements for a general DUT. Finally, wakefield accelerator measurements inherently have low signal-to-noise ratios. High noise levels often require a change in the DUT to achieve an appropriate signal-to-noise ratio.

The SWM was proposed as a method to estimate the beam

reverse the spectrum. Changing the audio cable connections to the SoftRock Lite circuit board from tip to ring and ring to tip will correct the reversed spectrum so that the SDR software works the same for the higher band receivers as with the lower band receivers. (See Cecil K5NWA'a explanation of the sub-harmonic sampling in his message on the Yahoo Softrock group.



Test Measurements

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1 □	"Lo Output" testpoint	MHz	18.73	18.73	_____

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Next Stage: Divider

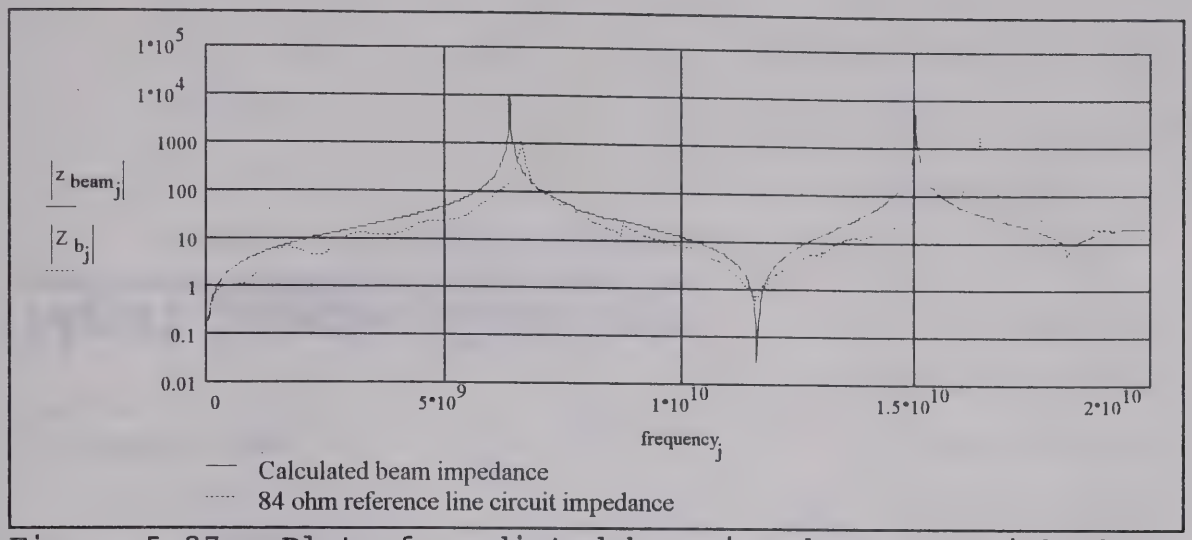

Figure 5-27. Plot of predicted beam impedance (Ω) with the measured circuit impedance (Ω) using an 84-Ω reference line versus frequency (Hz).

beam impedance is shown in Fig. 5-27. The measured cavity resonant frequency corresponds more closely with the 84-Ω reference line to the predicted beam impedance resonant frequencies. The 84-Ω line, however, did not accurately measure the magnitude of the beam impedance at the cavity resonance. At the cavity resonance, the 84-Ω line was off by one order of magnitude from the 50-Ω measurement. The 50-Ω line measured the magnitude of the beam impedance accurately but shifted the resonant frequencies.

D. Conclusion

Stretched wire measurements are a complicated measurement and great care must be exercised when using this technique. Because of the TEM loss mechanism the computations to solve Eq. 1-12 are generally easier for the

WB5RVZ.Org - Softrock Lite II Builder Notes

Softrock Lite II Softrock Lite II: Divider
Band: 20m

Introduction

General Info About the Stage

This stage will actually involve installing the remainder of the bottom-side SMT capacitors. In addition to the remaining SMT capacitors, you will also install two of the three bottom-side ICs:

- the Divider IC (U2), and
- the Mixer IC (U3)

Normally, the Mixer chip (U3) would be addressed in a separate "Mixer" Stage. However, due to the close proximity of the pads for the two Ics, U2 and U3, you will install it in this "Dividers" Stage.

The tests for U3 will be postponed until the "Mixer" Stage.

.

analyzer which made the frequency domain measurement had an upper limit on its frequency synthesizer, a comparison of the calculated frequency response to the frequency domain network analyzer measurement was desired. The results of this comparison are plotted in Figs. 5-18 and 5-19. Figure 5-18 is a frequency domain plot comparing the network analyzer measurement of $|s_{21}|$ to the Fourier transformed time domain measurement of transmission. Figure 5-19 is a plot showing the similarity of the inverse Fourier transform of $s_{21}(\omega)$ and the calculated impulse response from the time domain measurement of the cavity structure. These results show

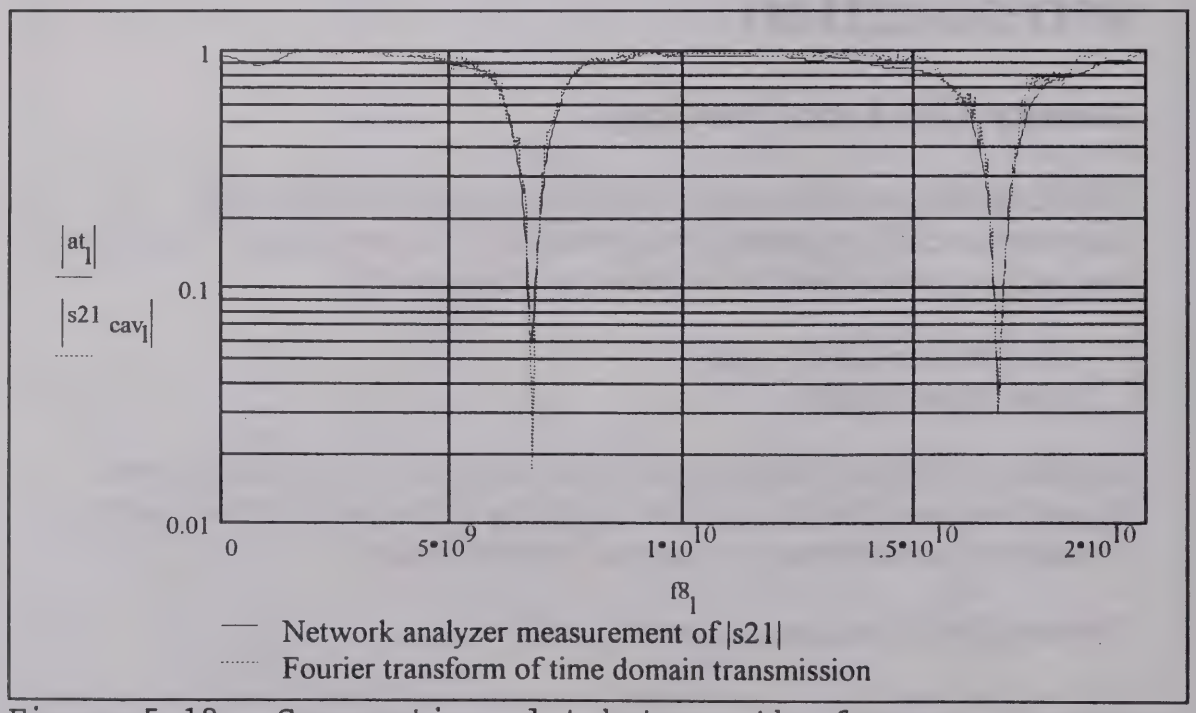

Figure 5-18. Comparative plot between the frequency response from the analysis of the time domain measurement to the network analyzer measurement.

Theory of Operation

The dividers accept as input the output of the local oscillator and divide that down to two signals that are ¼ the input frequency and in quadrature (90 ° out of phase with each other).

U2 is wired as a divide-by-4 synchroneous divider, clocked by the output from the Local Oscillator. Synchroneous clocking means that all stages switch at the same time, potentially offering a reduction of noise generated during switching.

The divider provides two LO outputs which clock Mixer, U3. Proper Operation of the Dividers may be monitored on a CW or SSB receiver tuned to Divider Output Frequency.

Note 1: A beat note should be heard when the antenna lead connected to a CW or SSB Receiver - tuned to Divider Output Frequency, is held near U2 on the SR Lite II PCB.

Note 2: All frequencies may be slightly below those stated in the table because of the loading capacitance is a little higher than specified for the nominal frequency of the Crystals supplied.

Because the 20m band uses subharmonic-sampling, the divider output (i.e., the center frequency") will be 4 thirds of the fundamental frequency of 18.73 MHz , or 14.0475 MHz.

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Stage Schematic

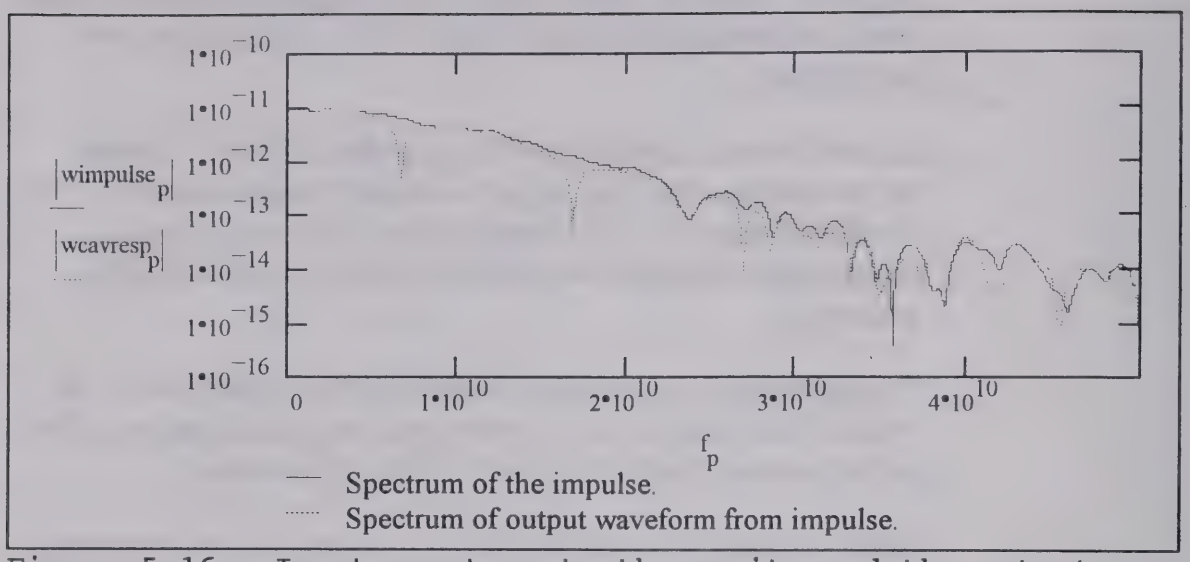


Figure 5-16. Input spectrum to the cavity and the output spectrum from the cavity due to the input to the cavity.

$$\int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$$

the frequency domain response was truncated at 28 GHz. The spectrum of the transmission $|H(\omega)|$ for the cavity is plotted in Fig. 5-17. Since the network

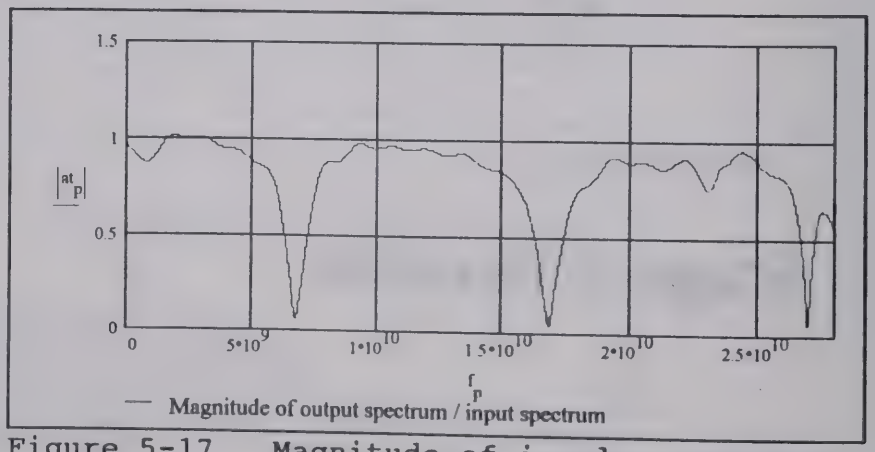
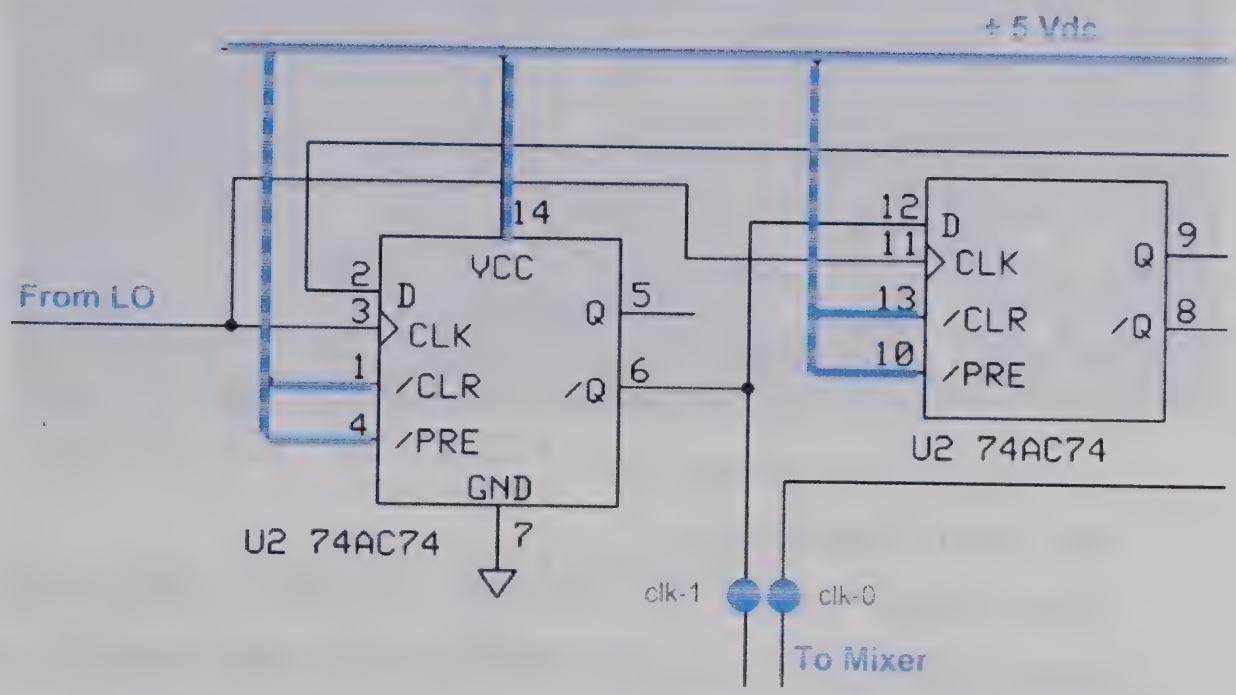


Figure 5-17. Magnitude of impulse response of cavity structure from time domain data.



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Board Layouts

Board Top

Go to Top of Page

Board Bottom

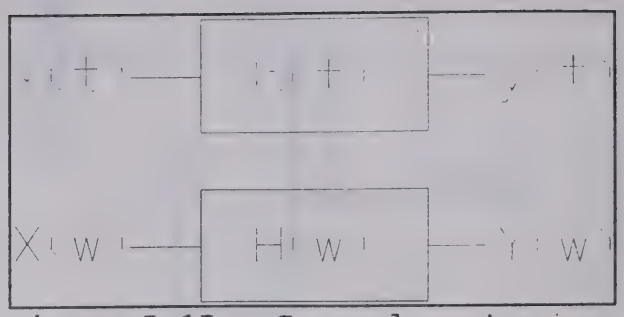


Figure 5-15. General system parameters.

to find the transfer function of the cavity. This was performed by first analyzing the problem in the frequency domain and then making the assumption that cavity network is a linear system. First, the spectrum of the time-domain input signal in Fig. 5-13 was calculated. Next the spectrum of the time-domain cavity response, $Y(\omega)$, in Fig. 5-15 to the input was calculated. Examination of the system and signals in Fig. 5-15 leads to the following definitions:

$x(t) \triangleq$ input signal

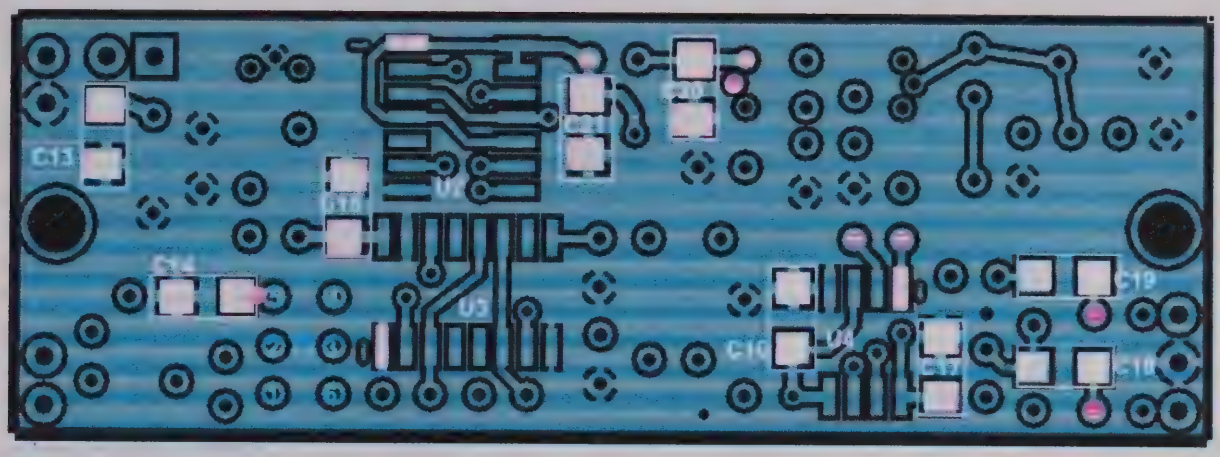
$y(t) \triangleq$ output response due to excitation $x(t)$

$h(t) \triangleq$ system transfer function

$$\therefore \quad H(\omega) = \frac{Y(\omega)}{X(\omega)}$$

The time domain data was assumed to be zero when the measurement data had the same of the order of magnitude as the noise floor of the sampling scope. [17] The spectra of the input signal, $X(\omega)$, and the output signal, $Y(\omega)$, are presented in Fig. 5-16.

Using Parseval's Fourier transform relationship:



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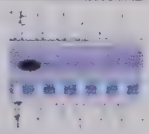
Divider Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
☐	boardhdw	HDW	2 X #4-40 hdw (nut, bolt, washer, spacer)	1		
☐	Capacitor	SMT 1206	0.01 uF	3	(smt) no stripe	
☐	Capacitor	SMT 1206	0.1 uF	4	(smt) black stripe	
☐	IC	SOIC 16	FST3253 mux/demux switch	1	FST3253 ESDIII	
☐	IC	SOIC 14	74AC74 Dual D FF	1	74AC74 ESDIII	

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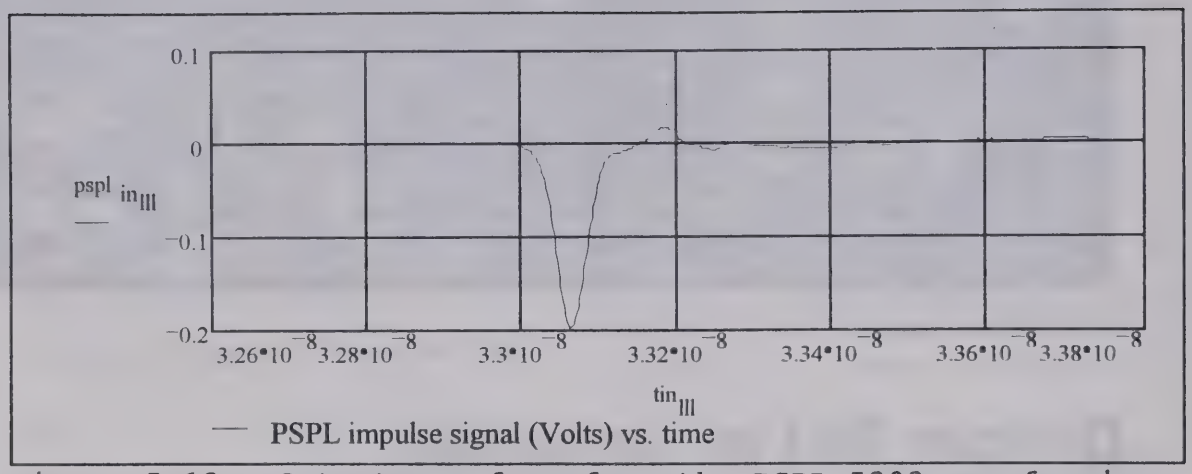


Figure 5-13. Output waveform from the PSPL 5208 waveforming network (V) versus time (s).

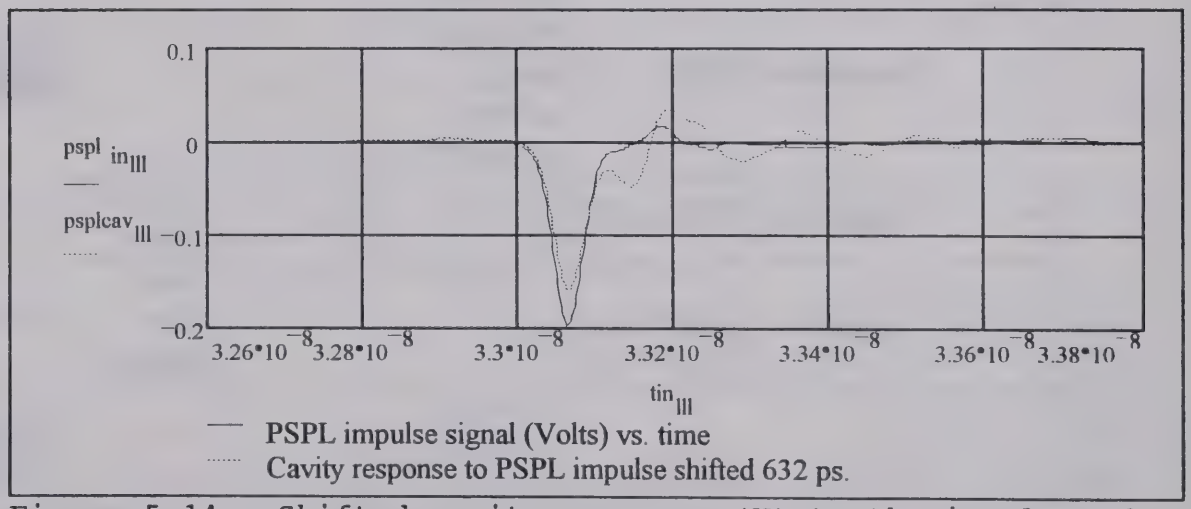


Figure 5-14. Shifted cavity response (V) to the impulse of Fig. 5-13 versus time (s).

response to the pulse of Fig. 5-13 is time shifted 632 ps resulting in Fig. 5-14. The time shift of the cavity response in Fig. 5-14 allows the plot of both the pulse and cavity response to be conveniently displayed on one graph.

To find the transmission of the cavity, it is necessary

Detailed Build Steps

Install remainder of the SMT Capacitors

We will use this stage to go ahead and install all of the remaining SMT bypass capacitors.

See hints on installing SMT Caps

The pads for the 0.1 uF capacitors are highlighted in white on the board shown above. These capacitors are in carrier strips marked with a black stripe.

The yellow markings pertain to the 0.01 uF capacitors.

Check	Designation	Component (top/bottom)	Orientation	Marking	Image	I
☐	C14	0.01 uF ((bottom))	yellow pads	(smt) no stripe		a
☐	C21	0.01 uF ((bottom))	yellow pads	(smt) no stripe		a
☐	C15	0.01 uF ((bottom))	yellow pads	(smt) no stripe		a
☐	C16	0.1 uF ((bottom))	white pads	(smt) black stripe		a

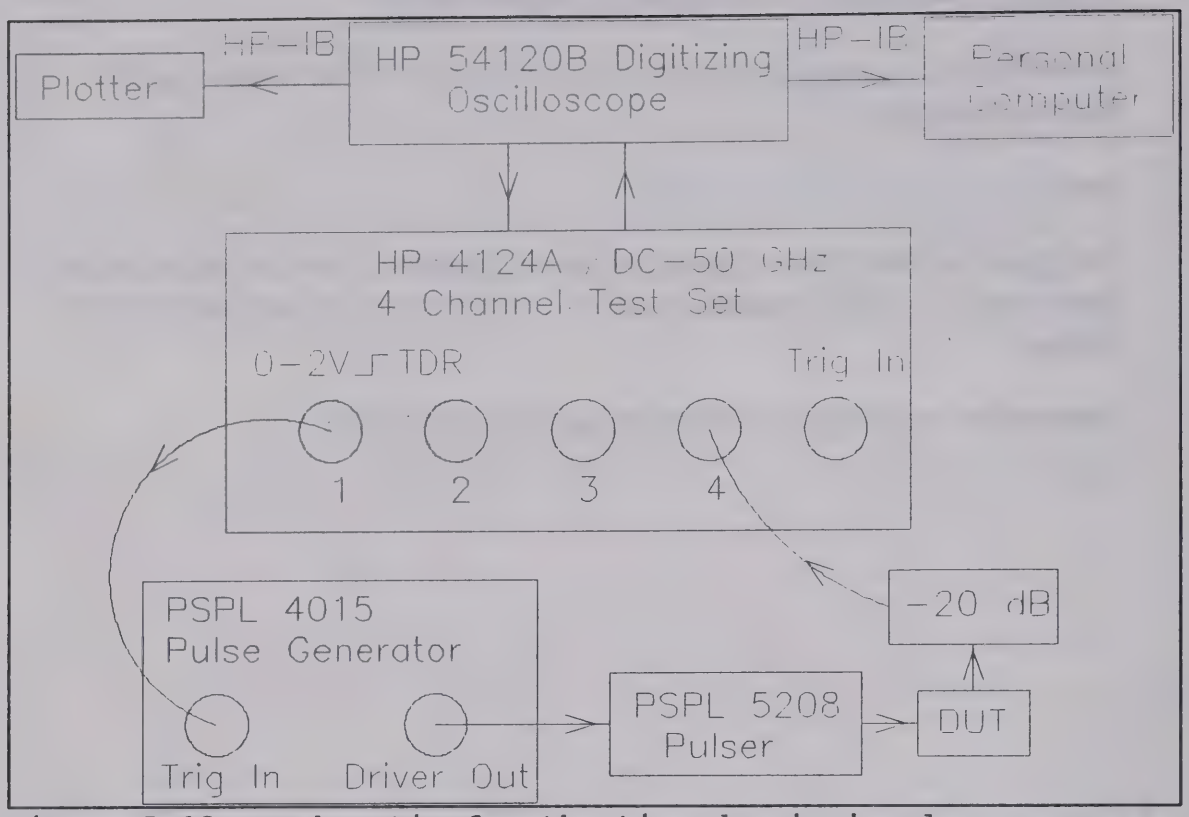


Figure 5-12. Schematic for the time domain impulse response stretched wire measurement for a general DUT.

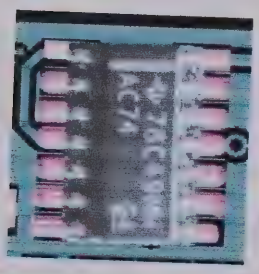
Picosecond Pulse Lab (PSPL) 4015 pulse generator. The PSPL 4015 produces a short rise-time step-function. The short step is fed into a matched passive waveforming network (PSPL 5208) which functions as a differentiator. Since the input to the PSPL 5208 is a step function then the output of the PSPL 5208 is an impulse. A plot of the measured impulse is shown in Fig. 5-13.

When the impulse from Fig. 5-13 is fed into the cavity of Fig. 5-9, the physical length of the structure causes the resulting waveform to be shifted in time. The cavity

☐	C17	0.1 uF ((bottom))	white pads	(smt) black stripe		a
☐	C18	0.1 uF ((bottom))	white pads	(smt) black stripe		a
☐	C19	0.1 uF ((bottom))	white pads	(smt) black stripe		a

Install U2

(Install U3 first (See 7 of 12)



Install 74AC74 (U2) on the SOIC-14 pads on the bottom side of the board. Take ESD precautions

See hints on installing SMT ICs

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
	U2	74AC74		ESD!	

Install U3

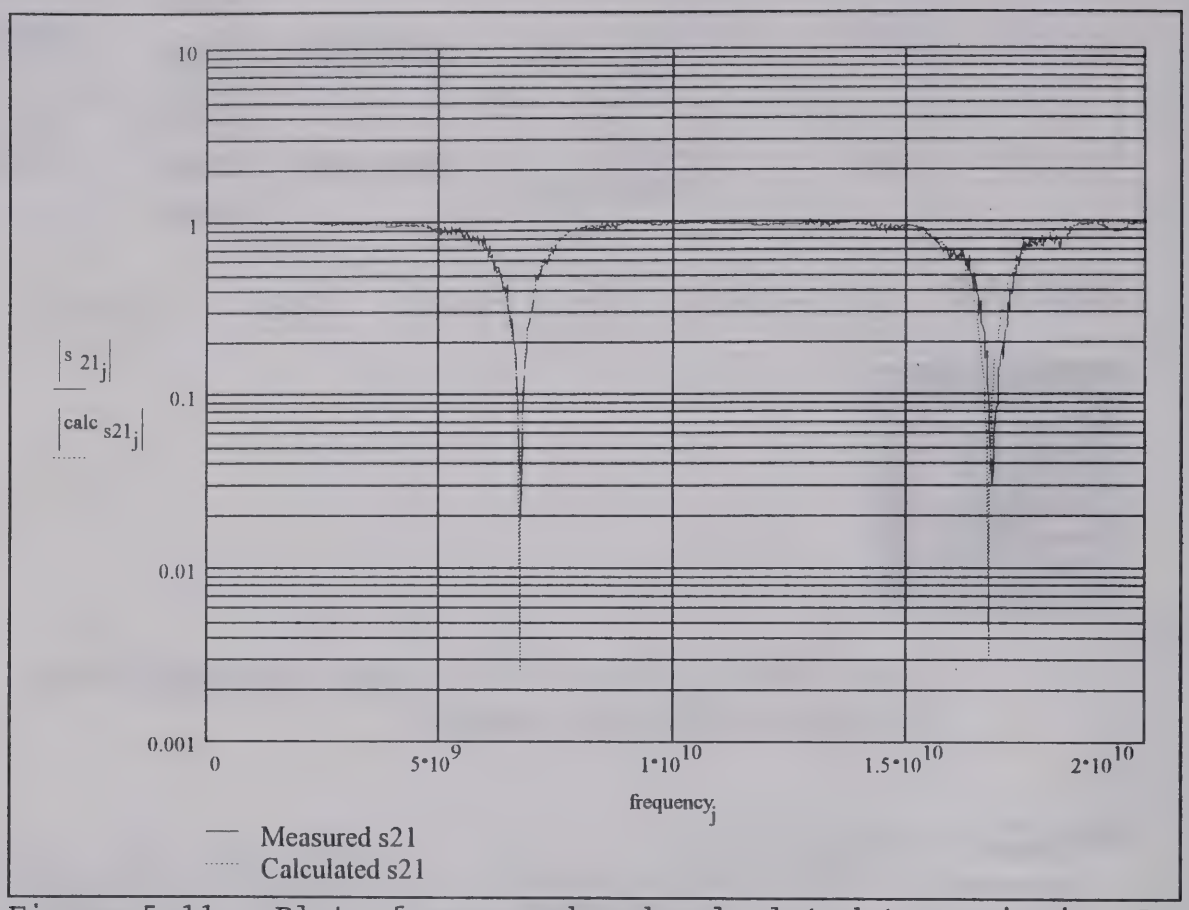
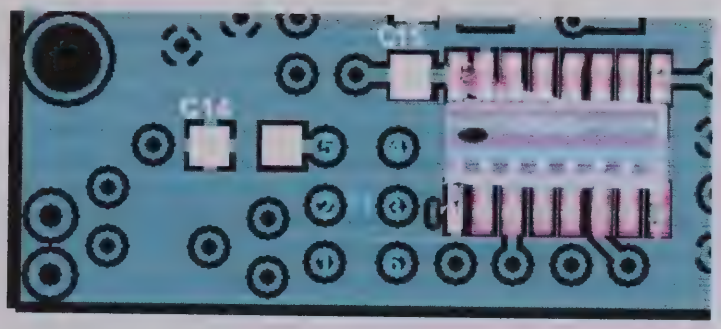


Figure 5-11. Plot of measured and calculated transmission S_{21} versus frequency (Hz).

capacitance from the series cavity impedance with the inductive coupling mechanism shown in Fig. 1-7.

iii. Time Domain Measurements and Results

The impulse response of the cavity structure in Fig. 5-9 was measured using the experimental setup in Fig. 5-12. A personal computer was used to record the measurement data from the HP 54120B 50 GHz sampling oscilloscope. Channel 1 on the HP 4124A produces a train of long rise-time step-functions at a low repetition rate (50 KHz) which trigger a



You should install the 16 pin Mixer chip (U3) BEFORE installing the 14 pin divider chip (U2), due to layout considerations which could complicate the soldering of the Ics. The mixer will be tested in a later stage.

See hints on installing SMT ICs

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
	U3			FST3253 ESD!	

Install Hardware

At this point you may install the two mounting screws and their associated hardware.

Install them with the screw head on the topside, then the board, then the spacer, then the washer, and finally the nut.

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
☐	hdw1	2 X #4-40 hdw (nut, bolt, washer,			

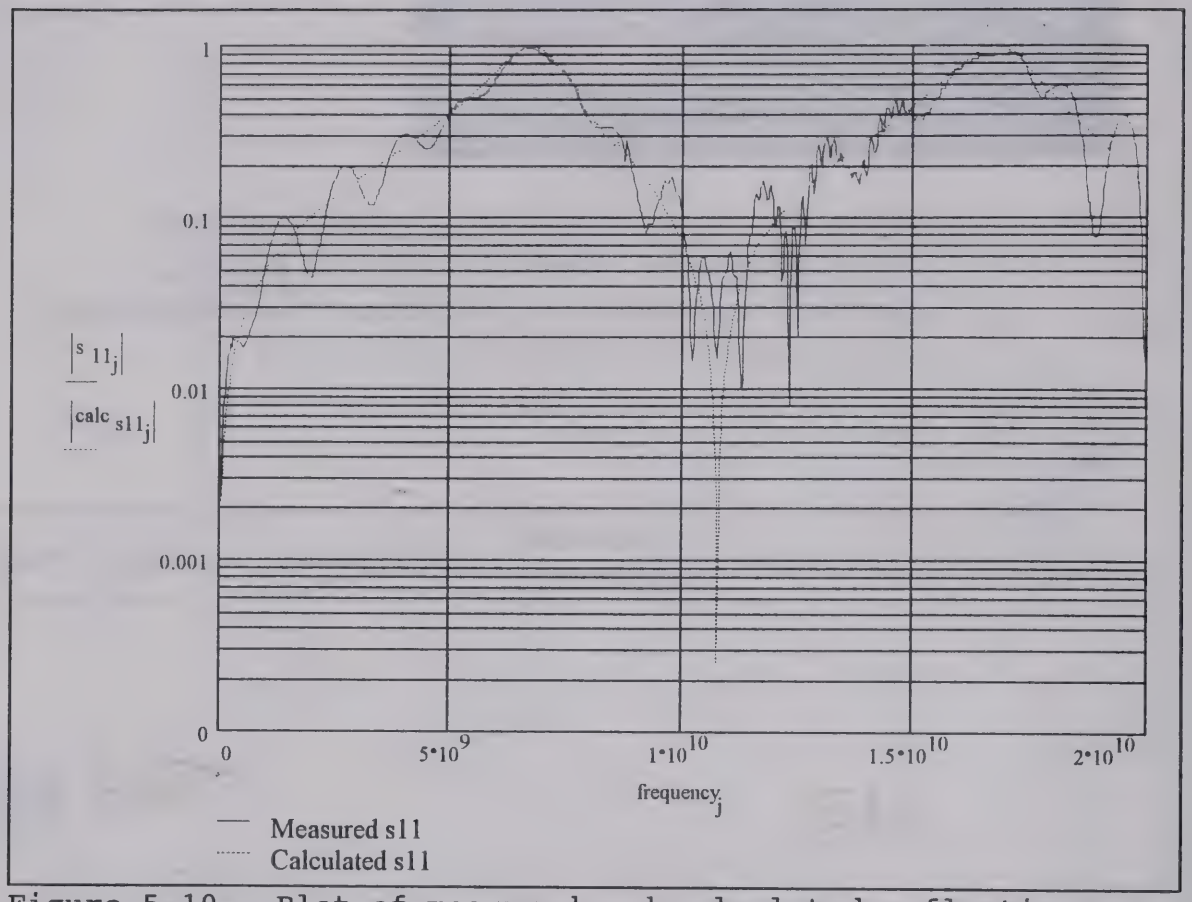


Figure 5-10. Plot of measured and calculated reflection versus frequency (Hz). The ripples in the measurement were caused by residual mismatches and discontinuities in the matching network.

prediction and reflection again showed excellent correspondence.

The $TM_{0,1,0}$ resonant frequency for a coaxial cavity with inner and outer radii at 0.274 cm and 1.95 cm, respectively, is 8.6 GHz, whereas the $TM_{0,1,0}$ resonant frequency for a pillbox cavity of radius 1.95 cm is 5.88 GHz. The sharp decreases in transmission in the measurement of Fig. 5-11 corresponds therefore to the parallel resonance of the net

		spacer) (top)			

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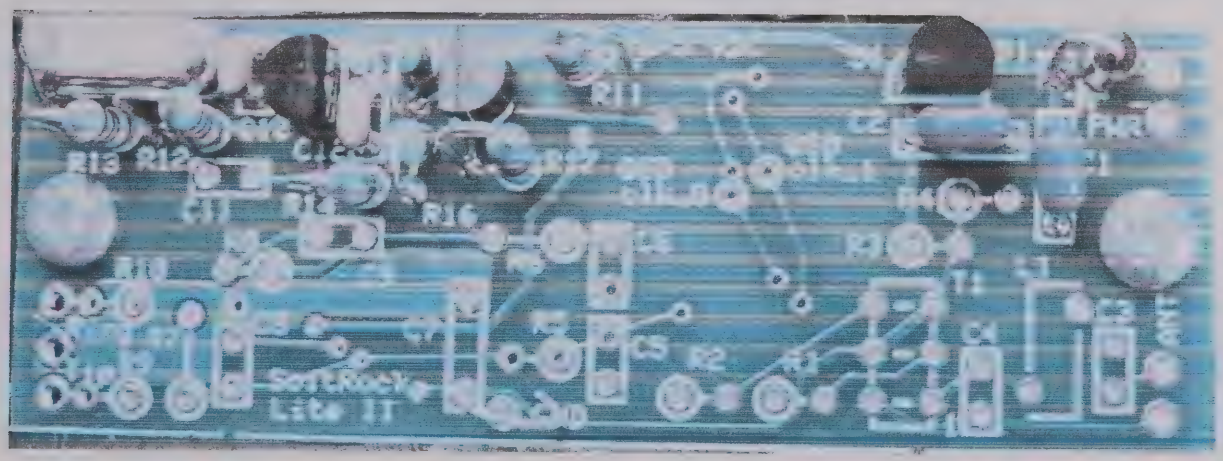
Completed Photos

Note: the completed pictures are of the 40m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside



View of Completed Underside

t=1.33 ns in Fig. 5-8b are caused by a small machining imperfection between the tapered and straight sections on port 1.

b. Pillbox Cavity Measurement and Prediction

After the reference data were collected, the reference line was disassembled and a single-cell pillbox cavity was carved into the housing. A drawing of the new geometry is depicted in Fig. 5-9. The frequency domain measurements of

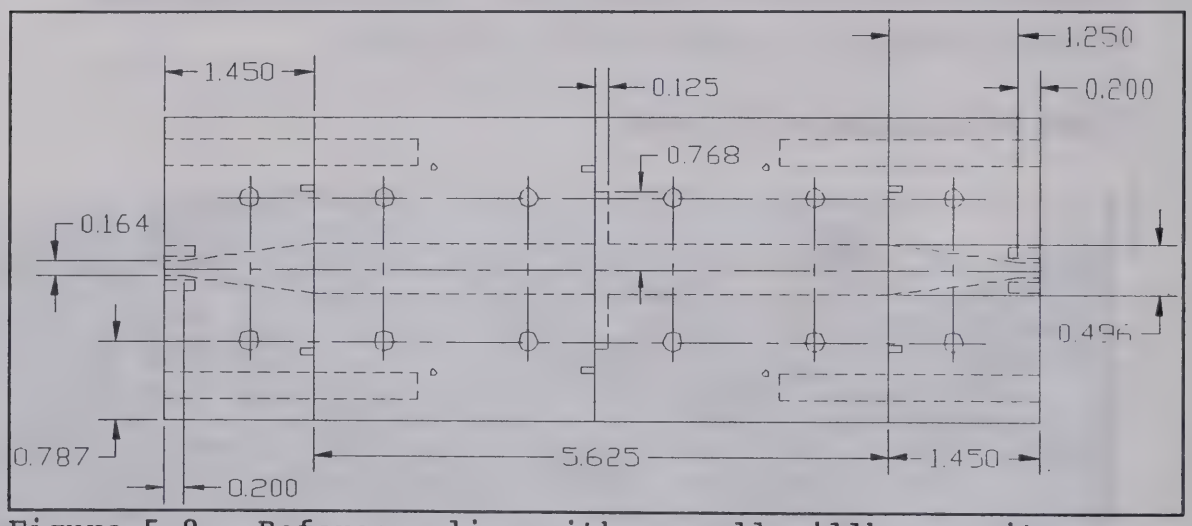
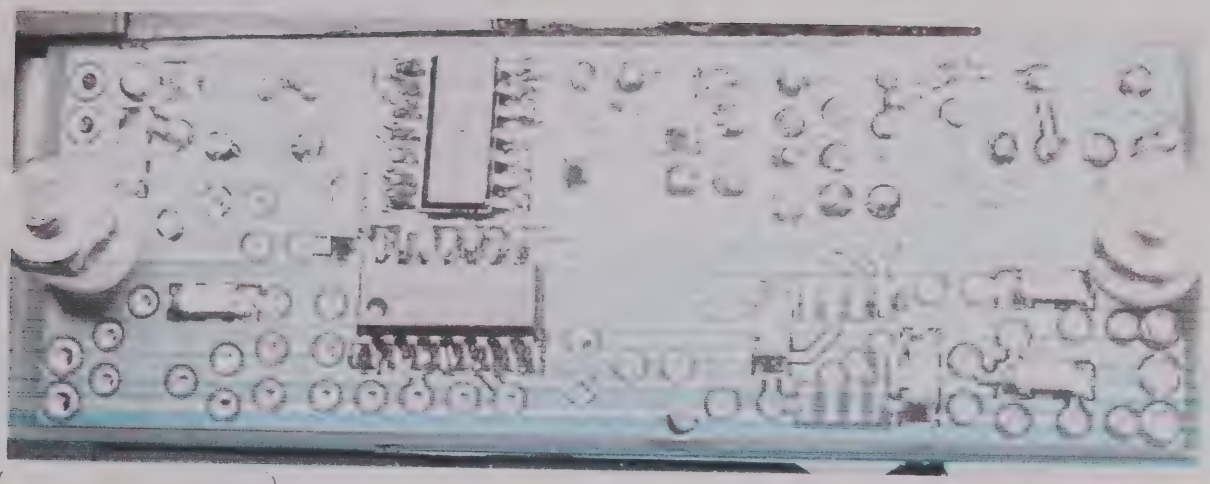


Figure 5-9. Reference line with a small pillbox cavity carved into the mid-section.

$|S_{11}|$ and $|S_{21}|$ are shown in Figs. 5-10 and 5-11, respectively. A close correspondence is seen between the predicted and measured reflection and transmission. The periodic ripple observed in Fig. 5-7 is again observed in Fig. 5-10, but only for frequencies away from the sharp resonances depicted in the $|S_{21}|$ measurement in Fig. 5-11. The phase of the



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Testing

Overview

Visual Check

Test Setup

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, [illegible]

Pay especial attention to the joints on the divider IC pins. If necessary, touch up the joints with your iron and/or [illegible] the flux. Wick up any excess [illegible]

Current Draw

Test Setup

- connect a 100 ohm resistor in series with the positive power lead
- apply 12 Vdc and measure the current draw with the limiting resistor in place
- [illegible]

Analysis of Ultra-relativistic Charged Particle Beam and Stretched Wire Measurement Interactions with Cylindrically Symmetric Structures

by

C. E. Deibele

A dissertation submitted in partial fulfillment
of the requirements for the degree of

Doctor of Philosophy
(Electrical Engineering)

at the

UNIVERSITY OF WISCONSIN - MADISON

1996

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
With the **100 ohm** current-limiting resistor	mA	< 20	18.0	_____
Without current limiting resistor	mA	< 25	18.1	_____

Voltage Tests

Test Setup

5
2.5 2% 5V rail

resonate with the electrical length of the tapered section.

Tiny pieces of solder embedded in the connectors, poor solder joints, and structural anomalies were detected by calculating the inverse Fourier transform of the reflection coefficients. The inverse Fourier transforms of $|S_{11}(\omega)|$ and $|S_{22}(\omega)|$ are plotted in Figs. 5-8a and 5-8b to verify that the reflections from each port of the reference line is of the same magnitude. The two large peaks in the impulse response of Figs. 5-8a and 5-8b represent the reflections caused by mismatches from each connector. The small ripples at time t=0.33 ns in Fig. 5-8a and time

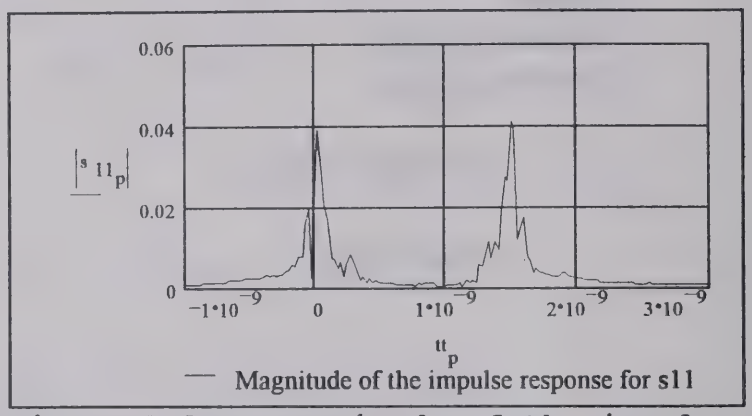


Figure 5-8a. Magnitude of the impulse response for s_{11} versus time (s). The two sharp peaks are reflections caused by each connector.

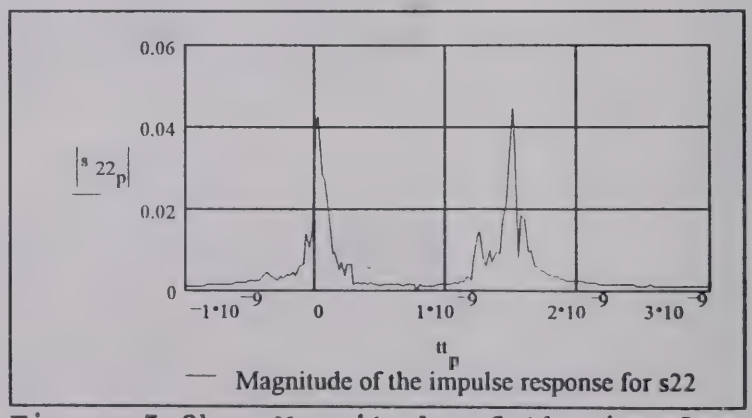
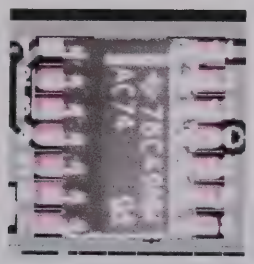


Figure 5-8b. Magnitude of the impulse response for s_{22} versus time (s). Note the similarity in the magnitude of the reflections with Fig. 5-7a.



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Pin 1	Vdc	5	4.9	_____
Pin 2	Vdc	2.5	2.48	_____
Pin 3	Vdc	3.5 - 4.5	4.1	_____
Pin 4	Vdc	5	4.9	_____
Pin 6	Vdc	2.5	2.47	_____
Pin 7	Vdc	0	0	_____
Pin 8	Vdc	2.5	2.48	_____
Pin 9	Vdc	2.5	2.48	_____
Pin 10	Vdc	5	4.9	_____
Pin 11	Vdc	3.5 - 4.5	4.1	_____
Pin 12	Vdc	2.5	2.47	_____
Pin 13	Vdc	5	4.9	_____
Pin 14	Vdc	5	4.9	_____

Divider Output

Test Setup

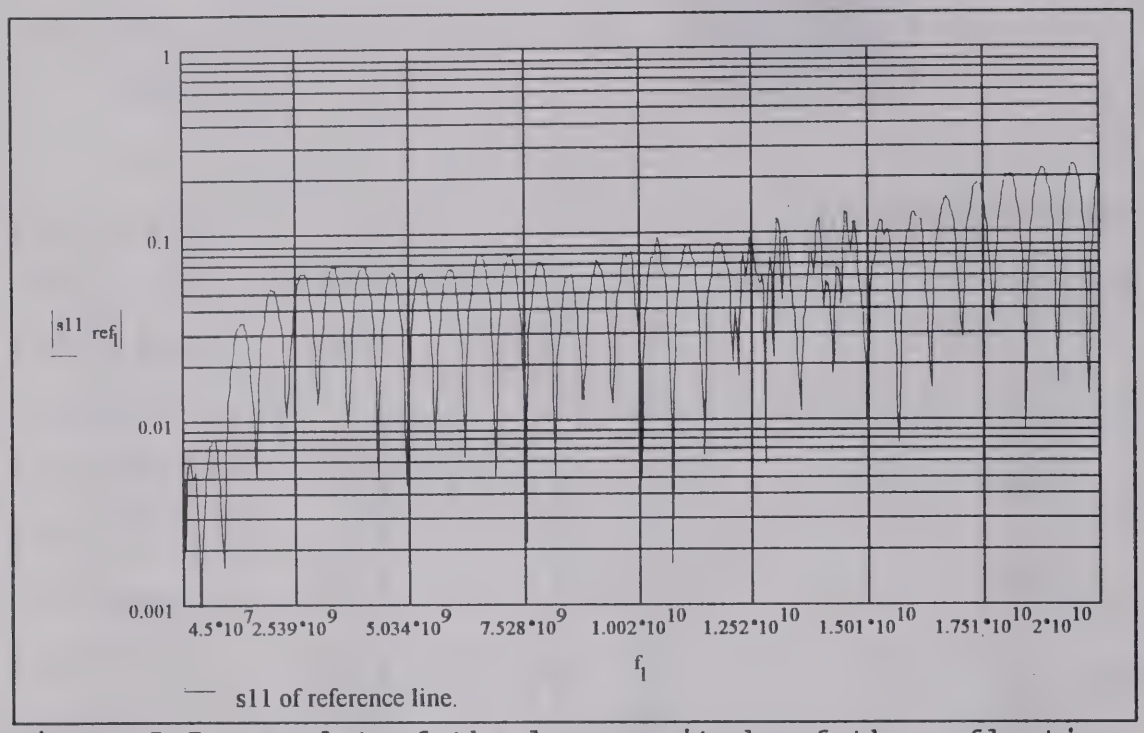
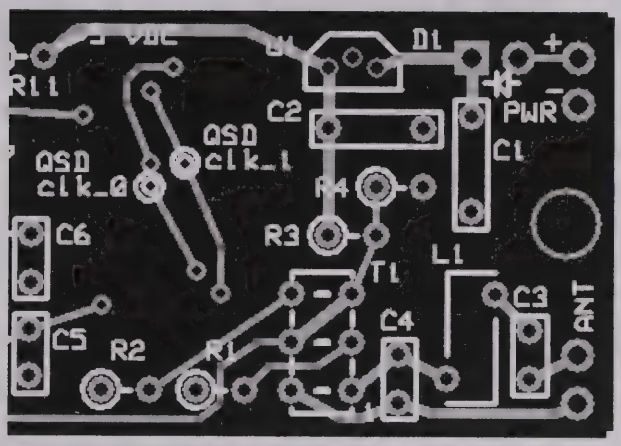


Figure 5-7. A plot of the log magnitude of the reflection coefficient (s_{11}) versus frequency (Hz). The periodic ripple is caused by mismatches between the SMA connectors in Fig. 5-4 and the tapered section of the reference line.

- The two linear tapered matching sections are not the same physical length and each of these lengths produces resonances at slightly different frequencies. This may cause the measurement to appear "noisy" when in fact multiple resonances appear close together.
- The tapered sections of the center conductor and the outer housing have radial geometrical differences. These include small angular differences in the tapered sections between the center conductor and housing as well as non-smooth interfaces between the tapered sections and straight sections. These reflections

a wire from its extreme to point "QSD Clk 0" and then point "QSD Clk1" on the graphic below. You should hear the signal in the receiver. You should also be able to pick up the third harmonic at 14.1875 MHz on your radio.



Divider Board

Mixer Test

Test Setup

tested later

The mixer installation will be tested in a [illegible] in the meantime, just carefully examine the soldering and placement of the IC using good magnification, any lens.

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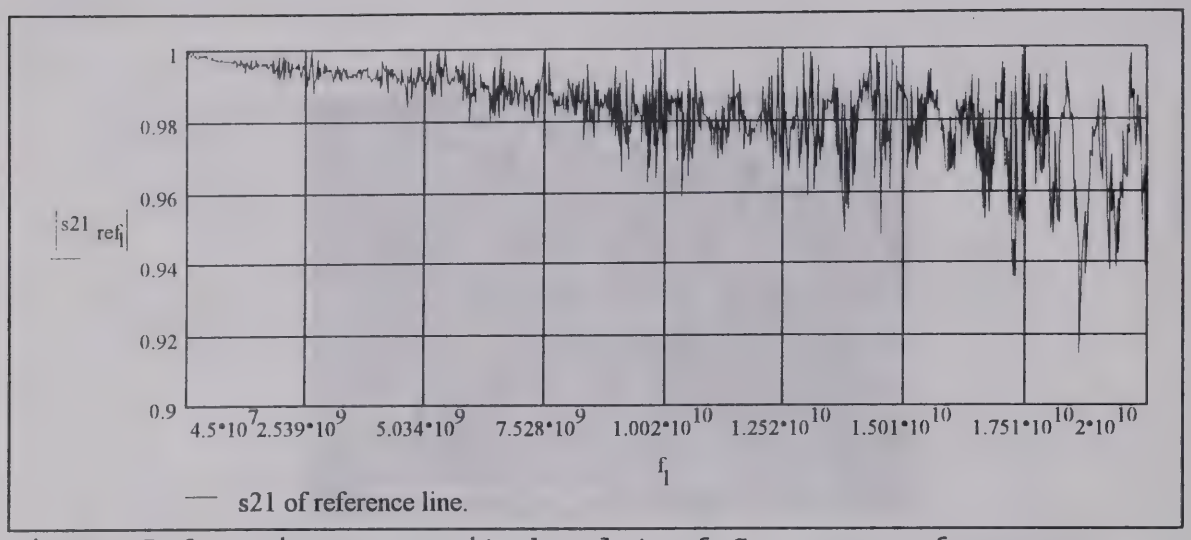

Figure 5-6. Linear magnitude plot of S_{21} versus frequency (Hz). The periodic ripple is a result of a resonance caused by mismatches of the connectors with the physical length of the reference line in Fig. 5-5.

was performed with a 20-GHz HP 8510C network analyzer. Figure 5-6 is a linear scale plot of the magnitude of the transmission (S_{21}) for the reference line. This plot shows relatively good transmission for the entire bandwidth of the measurement, having a minimum transmission $|S_{21}|$=0.915 at 18 GHz. The periodic ripple in the measurement is caused by a resonance between the physical length of the reference section and the dielectric mismatch at the interface between each connector and the tapered sections of the reference line. The ripple is easily observed in the measurement of reflection (S_{11}) depicted on a logarithmic scale in Fig. 5-7.

In the frequency range of 8.5-15.5 GHz small "noise-like" resonances can be seen. Several phenomena cause these small resonances including:

Softrock Lite II Softrock Lite II: Operational Amplifiers Band: 20m

Introduction

General Info About the Stage

Theory of Operation

The low-level In-Phase (I) and Quadrature (Q) IF signals from the Mixer are sampled over capacitors C5 and C6 (in the Mixer stage).

The opamps in this stage amplify the I and Q baseband signals by a factor of approximately 499, to compensate for the attenuation as a result of subharmonic quadrature sampling .

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Stage Schematic

changed the measured Q's of cavity modes. It is clear that care must be exercised and measurements must be scrutinized when using the center conductor to simulate a beam of relativistic charge.

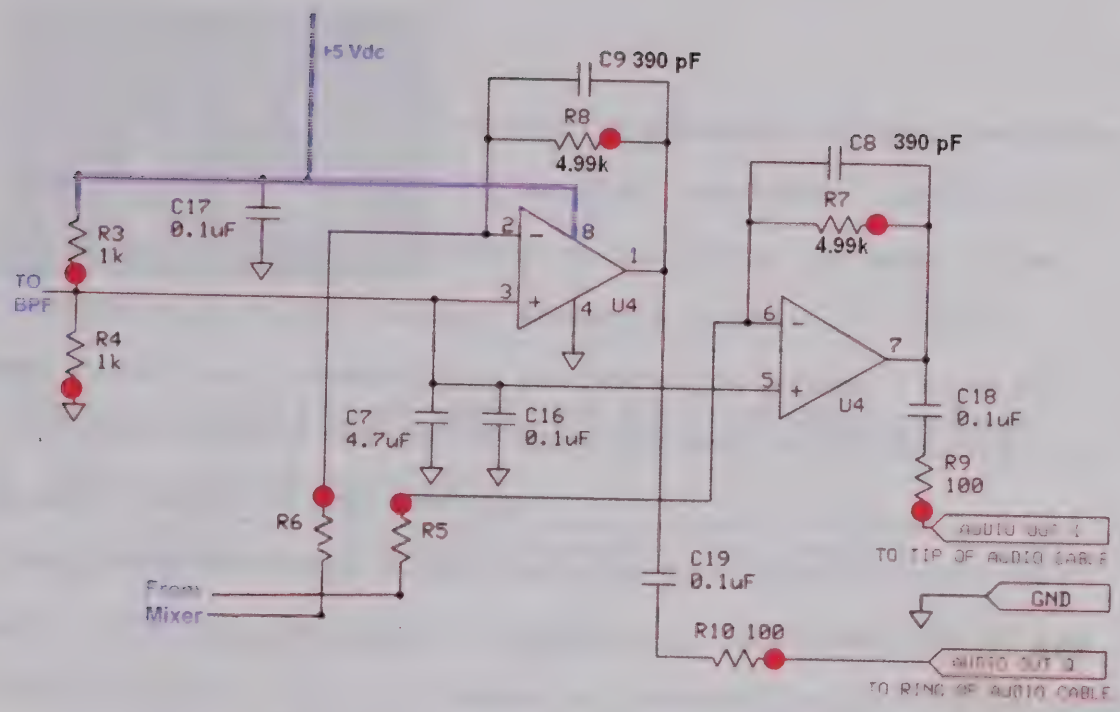
C. Measurement Data

i. Introduction

The goal of this dissertation is to compare the stretched wire measurement with a real beam measurement. The real beam measurement is described in Ch. IV and was performed by Simpson et. al. The stretched wire measurement was designed around the parameters Simpson used in his experiment:

- a=0.63 cm / 0.248 in.
- b=1.95 cm / 0.768 in.
- g=0.32 cm / 0.125 in.
- r_o=0.274 cm / 0.108 in. ≒ 50-Ω reference line.

A reference line, shown in Fig. 5-5, was constructed out of eight individual and interlocking pieces of brass to fit the geometry dictated by Simpson's experiment. Two linear tapered sections change the geometry from the 50-Ω cables connected to the ports on the network analyzer to a 50-Ω air dielectric coaxial transmission line. The outer diameter of the straight section is equal to Simpson's beampipe diameter. Commercially purchased SMA connectors were soldered to the machined center conductor to make stretched wire



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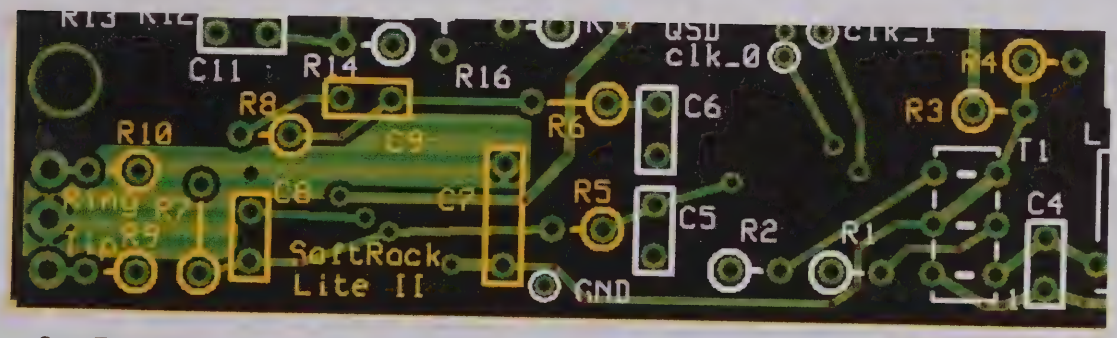
Board Layouts

Board Top



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Board Bottom

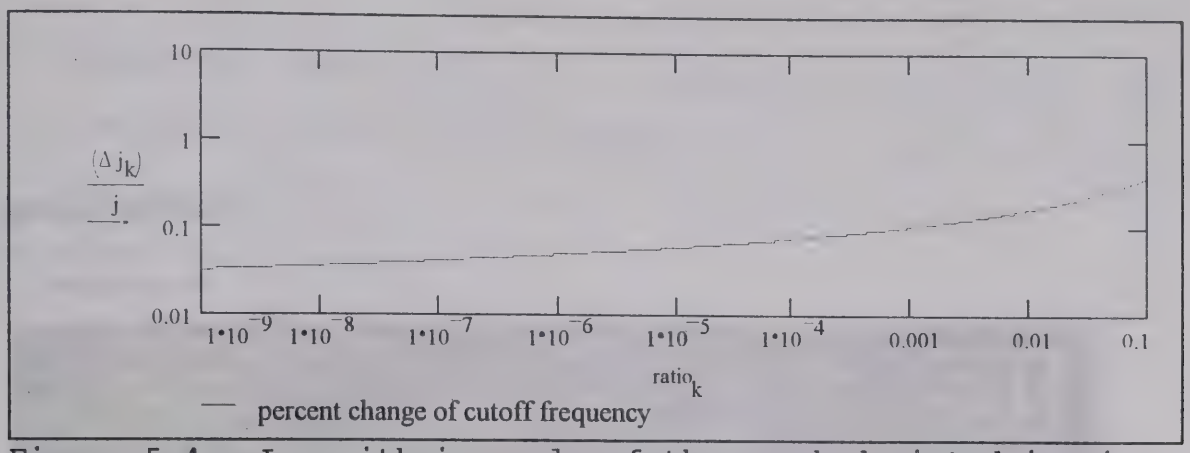
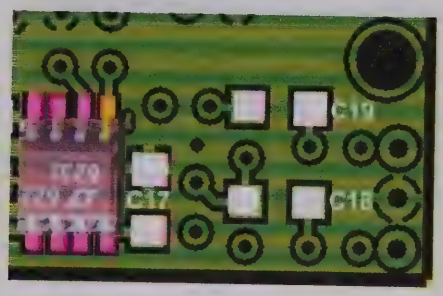


Figure 5-4. Logarithmic scale of the graph depicted in Fig. 5-3.

approaches a constant value of $\frac{\Delta j}{j_1} \approx 0.15$. Changing the axis to a logarithmic scale in Fig. 5-4 allows a more detailed view of the origin and the dependence of $\frac{\Delta j}{j_1}$ for small $\frac{r_o}{a}$. Mathematically, it is clear that in the limit of $\frac{r_o}{a} \to 0$ that $\frac{\Delta j}{j_1} \to 0$. It is not practical for $\frac{r_o}{a} \to 0$ and perhaps only a ratio of $\frac{r_o}{a} \approx 0.05$ is in practice achievable. Using the limiting ratio $\frac{r_o}{a} = 0.05$ causes a frequency shift $\frac{\Delta j}{j_1}$ of about 25%. Shifting the cutoff frequency of the beampipe by 25% is significant and this effect *must* be included in the final interpretation of the results.

Most network analyzers and microwave measurements are made using 50-Ω coaxial TEM transmission lines. From Fig. 5-3, using a 50-Ω TEM coaxial geometry (i.e., $\frac{r_o}{a} \approx \frac{1}{2.3}$) requires the cutoff frequency of the first TM mode to be almost *doubled* from that of an open beampipe. Figure 5-2 showed that shifting the cutoff frequencies of the beampipe



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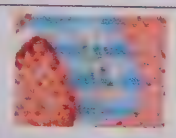
Operational Amplifiers Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
☐	Capacitor	Ceramic	390 pF 5%	2	391	
☐	Capacitor	Ceramic	4.7 uF 10% 16V X/R RAD	1	475	
☐	IC	SOIC-8	LT6231 dual op-amp	1	LT6231 ESD!!!	
☐	Resistor	1/4W	10 ohm 1/4W 1%	2	br-blk-blk-gld-br	
☐	Resistor	1/6W	100 1/6W 5%	2	br-blk-br-gld	
☐	Resistor	1/4W	1 k 1/4W 1%	2	br-blk-blk-br-br	
☐	Resistor	1/4W	4.99 k 1/4W 1%	2	y-w-w-br-br	

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Detailed Build Steps

Install OpAmp

take the Taylor series expansion of both $J_0(x)$ and $Y_0(x)$ about the point $x=j_1$. After several algebraic manipulations, it is possible to show that:

$$\frac{\Delta j}{j_1} \triangleq \frac{i_1 - j_1}{j_1}$$

varies directly (for $\frac{r_o}{a} \ll 1$) with the ratio

$$\frac{\Delta j}{j_1} \propto \frac{1}{\ln(\frac{r_o}{a})}.$$

Figure 5-3 is a linear scale plot of $\frac{\Delta j}{j_1}$ versus the ratio of center conductor radius (r_o) to the beampipe outer conductor radius (a). Near $\frac{r_o}{a} \approx 0$ in Fig. 5-3, it appears as if $\frac{\Delta j}{j_1}$

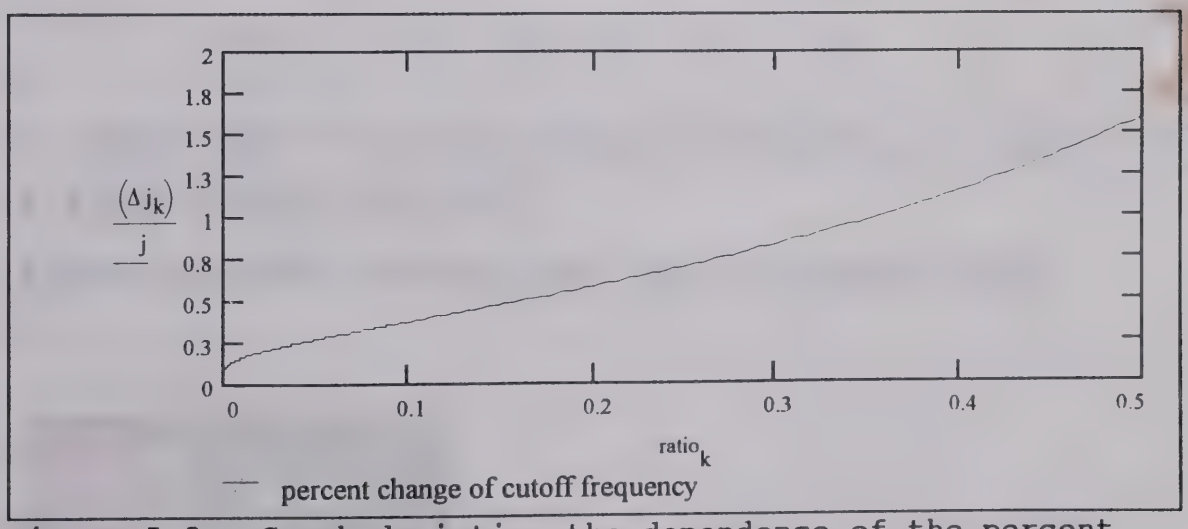
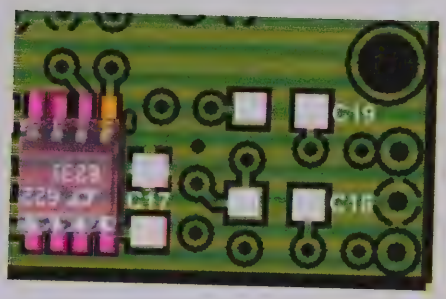


Figure 5-3. Graph depicting the dependence of the percent change in cutoff frequency on the ratio of center conductor to outer conductor.



Install the LT6231 operational amplifier to the bottomside of the board.

See hints on installing SMT ICs

- Orient U4 on its pads so that the pin 1 corner of the IC matches the small "1" (it also looks like a "0") mark in the copper on the bottom side of the board. In general, pin 1 of an SOIC packaged IC is in the lower left corner of the package when the printing on the package top reads upright, from left to right.
- Tack-solder one corner pin of U4 and reheat the tacked pin as necessary to line up U4 on its pads properly.
- Double-check the orientation of U4 and the line up of the IC on its pads with magnification and good lighting. You do NOT want to install U4 oriented incorrectly. If all is well, carefully solder the rest of the leads to their pads.

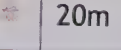
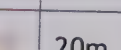
Check	Designation	Component (top/bottom)	Orientation	Marking	Image	Band	No
☐	U4	LT6231 dual op-amp ((bottom))		LT6231 ESD!!!		any	

Install band-specific components

Install the band-specific capacitors and resistors.

See hints on orienting and installing resistors

See hints on identifying and installing ceramic caps

Check	Designation	Component (top/bottom)	Orientation	Marking	Image	Band	Not
☐	R05	10 ohm 1/4W 1% (top)	E-W	br-blk-blk-gld-br		20m	
☐	R06	10 ohm 1/4W 1% (top)	E-W	br-blk-blk-gld-br		20m	

Install remaining components

See hints on orienting and installing resistors

since the wire introduces an effective loss mechanism to all cavity modes.

B. Center Conductor Cutoff Effects

It is important to know the effect of the relative size of the center conductor on the cutoff frequency of the beampipe in order to know how the solution of the open beampipe compares to the solution of the stretched wire measurement.

In the following work, it is assumed that the region of interest only includes the first cutoff frequency. The method is general enough such that it can be applied to any of the cutoff frequencies and the results are likewise similar. Consider the two transcendental equations which respectively determine the set of cutoff frequencies for the case of the open beampipe and the stretched wire measurement:

$$J_0(j_1)=0 \qquad J_0(i_1)\,Y_0(i_1\frac{r_o}{a})=J_0(i_1\frac{r_o}{a})\,Y_0(i_1) \tag{5-1}$$

where

$$k_{cutoff}=\frac{j_1}{a} \qquad k_{cutoff}=\frac{i_1}{a}.$$

Assuming that $\frac{r_o}{a}\ll 1$, substitute the small argument form of the Bessel functions [15] into the formulae of Eq. 5-1, and

See hints on identifying and installing ceramic caps

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
☐	C08	390 pF 5% (top)		391	
☐	C09	390 pF 5% (top)		391	
☐	C07	4.7 uF 10% 16V X7R RAD (top)		475	
☐	R07	4.99 k 1/4W 1% (top)	S-N	y-w-w-br-br	
☐	R03	1 k 1/4W 1% (top)	W-E	br-blk-blk-br-br	
☐	R08	4.99 k 1/4W 1% (top)	E-W	y-w-w-br-br	
☐	R04	1 k 1/4W 1% (top)	W-E	br-blk-blk-br-br	
☐	R09	100 1/6W 5% (top)	E-W	br-blk-br-gld	
☐	R10	100 1/6W 5% (top)	E-W	br-blk-br-gld	

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Completed Photos

Note: the completed pictures are of the 40m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside

corresponding to a lumped circuit element of:[2]

$$Z_{circuit}(\omega) \approx \frac{ikZ_o \ln(\frac{b}{a})g}{2\pi}.$$

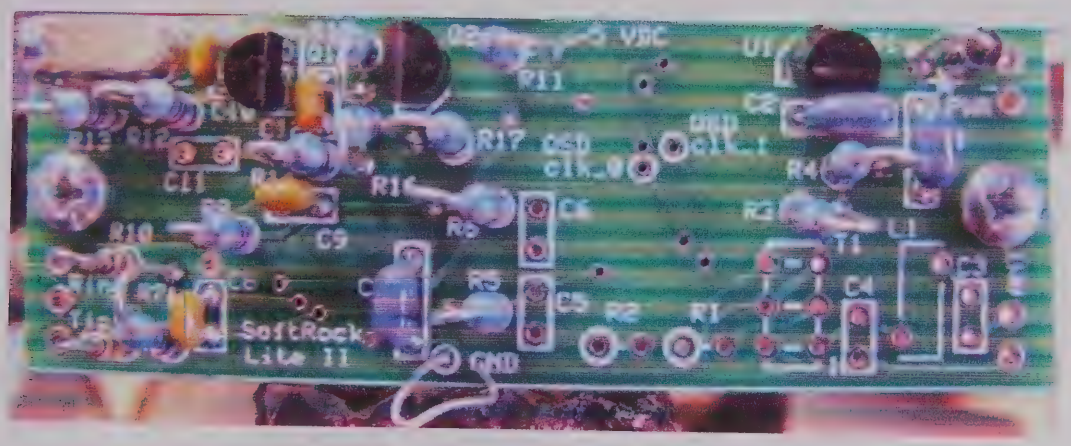
Again, this equation is correct to first order. If frequency is low enough such that the higher order terms can be neglected, the TEM circuit impedance converges to the beam impedance exactly. The presence of the magnetostatic cavity mode allows the circuit impedance to converge to the beam impedance. The low frequency circuit model derived in this section is different than the high frequency model presented in Fig. 1-7 in Ch. I.C. The difference in each respective model represents different frequency assumptions.

vii. Summary

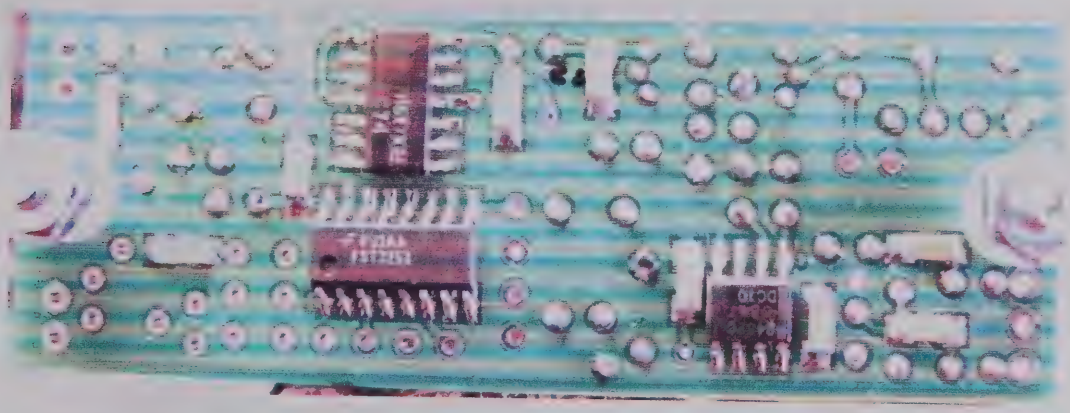
The presence of the wire can dictate a strong cavity mode evanescence caused by the addition of the TEM loss mechanism. Ironically, the presence of the wire may also cause the measured Q of a particular cavity mode to increase if the shift in pipe cutoff frequency changes about the cavity resonant frequency and the TEM mode can be neglected. The introduction of the wire requires a new pipe kernel in Eq. 1-12. The wire may decrease the post-computation work

---

[2] A description of the formulation for calculating the circuit impedance from S_{21} is found in Appendix E.



View of Completed Underside



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Testing

Overview

Warning

Take appropriate ESD precautions in these tests, since you will be working around the sensitive OpAmp IC

Visual Check

Test Setup

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the OpAmp IC pins. If

and has a numerically predictable relationship to the $\theta_{0,0}$ calculated for the open beampipe. The first term, however, is the result of the TEM contribution to E_z. Expanding this expression for $kg \approx 0$ shows that there is *no* TEM contribution to E_z.

Inserting the results of the calculation of $\theta_{0,0}$, $\xi_{0,0}$, and ϕ_0 into Eq. 4-7 produces

$$(\theta_{0,0T}+\xi_{0,0DC}+\xi_{0,0T})\,\Upsilon_0=\phi_0.$$

Solving for Υ_0 results in

$$\Upsilon_0=\frac{-ikZ_oI_o\ln(\frac{b}{a})}{2\pi\left(1+\frac{k^2a^2\ln(\frac{b}{a})}{2\pi g}\left[\theta_{0,0T}+\xi_{0,0T}\right]\right)}.$$

The transmission coefficient is found by substituting the Υ_0 into Eq. 1-10. This results in a calculated transmission coefficient of

$$s_{21}(\omega)=1-\frac{i\omega g\ln(\frac{b}{a})}{2c\ln(\frac{a}{r_o})\left(1+\frac{k^2a^2\ln(\frac{b}{a})}{2\pi g}\left[\theta_{0,0T}+\xi_{0,0T}\right]\right)},$$

necessary, touch up the joints with your iron and/or some flux. Wick up any excess.

Current Draw

Test Setup

- In each test, the ammeter must be placed in series between the positive lead of the power source and the board's positive power-in "+" terminal.
- In one test there is also a 100 ohm resistor in the series "chain" as well.
- in the second test, the setup is the same except that the current-liminting resistor is removed

Apply 12 Vdc to the board for this test

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
With **100 ohm** current-limiting resistor	mA	< 30	26.6	_____
Without current limiting resistor	mA	< 30	26.9	_____

Voltage Tests

Test Setup

Measure the voltages with respect to ground for each of the pins of U4. Tage care to measure at the actual IC pin rather than the pad, so as to ensure you are measuring the PIN voltage

expected voltages are indicated in the table below:

- 5 V (range of 4.5 - 5.4)
- 2.5 V (approx 50% of the 5V rail value)

$$Z_{beam}(\omega) = -\frac{1}{q}\int_0^g E_z e^{ikz} dz = -\frac{1}{q}\int_0^g Y_0 e^{ikz} dz \approx -Y_0 \frac{g}{q}$$

$$\therefore Z_{beam}(\omega) = \frac{ikZ_0 \ln(\frac{b}{a})g}{2\pi\left(1 + \frac{k^2 a^2 \ln(\frac{b}{a})}{2\pi g}\left[\theta_{0,0} + \xi_{0,0T}\right]\right)} \approx \frac{i\omega Z_0 \ln(\frac{b}{a})g}{2\pi c}.$$

This equation is correct to first order, and shows the well-known result that the beam impedance of a change in beampipe diameter equates to magnetic energy storage. [14]

c. Calculation of S_{21}

The mathematics of the center conductor beampipe requires an additional term (from the additional TEM mode) that the open beampipe did not possess. Using Eq. 1-8 in the definition of $\theta_{0,0}$ reveals:

$$\theta_{0,0} = \frac{2\pi i}{a}\sum_{s=0}^{\infty}\frac{\alpha_s}{\tilde{b}_s}\int_0^g\int_0^g dx\,dy\, e^{-i\frac{\tilde{b}_s}{a}|x-y|}$$

$$= \frac{2\pi\alpha_0}{k^2 a^2}\left[-2ig + \frac{2(1-e^{-ikg})}{k}\right] + \theta_{0,0T}.$$

The second term in this expression, $\theta_{0,0T}$, is a real number

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Pin 1	Vdc	2.5	2.46	_____
Pin 2	Vdc	2.5	2.46	_____
Pin 3	Vdc	2.5	2.46	_____
Pin 4	Vdc	0	0	_____
Pin 5	Vdc	2.5	2.46	_____
Pin 6	Vdc	2.5	2.46	_____
Pin 7	Vdc	2.5	2.46	_____
Pin 8	Vdc	5	4.94	_____

Functional Test

Test Setup

You will test the DC gain of each of the op-amps by connecting resistors R_B from each op-amp inverting input to circuit ground. Introducing the "bridging" resistor R_B will result in a test current equal to 2.5 / R_t which will be balanced by the current fed back from each op-amp's output through each feedback resistor, R_F (i.e., R7 or R8). Each op-amp output will increase in voltage by 2.5 * R_F/ R_B from the nominal DC level of 2.5 volts.

The value of the "bridging" resistor (R_B) is 10 kΩ:

- **Test the First OpAmp**

  Power up the circuit and measure the voltage at pin 1 of the op-amp (hairpin of R8). It should be ~2.5 Vdc
- Power off and use clip leads to connect R_B between the hairpin of R6 and circuit ground. (This provides an input resistance(R_i) of 10 kΩ
- Power up and measure the output voltage at the hairpin of the feedback resistor R8. You should get:, with R_B=10 kΩ and R8=4.99 kΩ: ~3.75 Vdc.
- Remove R_B and the output voltage at R8 should go back to ~2.5 Vdc.

$\frac{V_{out}}{R_8} = \frac{2.5}{R_B}$

$V_{out} = \frac{2.5}{\ } = 1.25$

- **Test the Second OpAmp**

  Power up the circuit and measure the voltage at pin 7 of the op-amp (hairpin of R7). It should be ~2.5 Vdc
- Power off and use clip leads to connect R_B between the hairpin of R5 and circuit ground. (This provides an input resistance(R_i)

The truncation error of $\xi_{0,0}$ is therefore the sum of all the cavity modes besides $\xi_{0,0\ DC}$. The truncation is a sum which is a real constant that can be calculated. Define the truncation error ξ_T:

$$\xi_{0,0} \triangleq \xi_{0,0DC} + \xi_T .$$

The terms $\xi_{0,0\ DC}$ and ϕ_0 are both singular as $k \to 0$. For low frequencies note that $\xi_{0,0\ DC} \gg \xi_T$.

Calculating $\theta_{0,0}$ using Eq. 4-3 with the pipe kernel of Eq. 1-6 shows that $\theta_{0,0}$ is bounded for $k \to 0$. Comparing $\theta_{0,0}$ to $\xi_{0,0}$ reveals $\theta_{0,0} \ll \xi_{0,0}$. This implies that the dominant factors in the linear equation are the DC cavity mode and the excitation source. Inserting $\theta_{0,0}$, $\xi_{0,0}$, and ϕ_0 into Eq. 4-7 identifies the linear relationship:

$$(\theta_{0,0} + \xi_{0,0\,DC} + \xi_T)\, Y_0 = \phi_0 .$$

Solving for Y_0 results in

$$Y_0 = \frac{-ikZ_o I_o \ln\left(\frac{b}{a}\right)}{2\pi\left(1 + \frac{k^2 a^2 \ln\left(\frac{b}{a}\right)}{2\pi g}\left[\theta_{0,0} + \xi_T\right]\right)} .$$

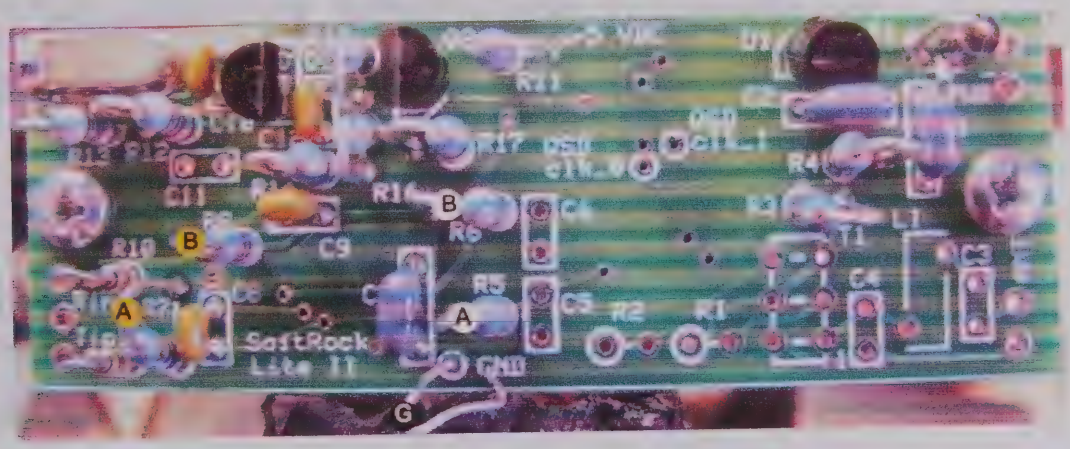
Inserting the definition of Y_0 into the normalized definition of beam impedance in Eq. A-1 results in:

of 10 kΩ

- Power up and measure the output voltage at the hairpin of the feedback resistor R7. You should get, with R_B=10 kΩ and R7=4.99 kΩ: ~3.75 Vdc.
- Remove R_B and the output voltage at R7 should go back to ~2.5 Vdc.

The diagram below shows the test points. The yellow dots show the output voltage measurement points. The white points show the bridging resistor connection points (connect the bridging resistor R_B between the ground and a white point). To measure the voltage at yellow point "A", use white point "A" for the bridge; same with points "B".

An excel spreadsheet with a calculator for this test is available for you to plug in your bridging resistor ohms (Rt) and your pin 1 or pin 7 normal voltages (E_{bias}) and predict the expected voltage when bridged (E_{out}).



Functional Test"

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
R7 (yellow "A")- unbridged	Vdc	2.5	2.48	_____
R8 (yellow "B") - unbridged	Vdc	2.5	2.46	_____
R7 (yellow "A") bridging white "A" to ground	Vdc	3.75	3.72	_____
R8 (yellow "B") bridging white "B" to ground	Vdc	3.75	3.69	_____

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and one unknown. The Θ and Ξ matrices each become a 1x1 matrix whose only element is $\theta_{0,0}$ and $\xi_{0,0}$ respectively. The Φ vector contains one element, ϕ_0. The constants of the linear equation, namely $\xi_{0,0}(\omega)$ and $\phi_0(\omega)$, need to be calculated once since their definitions do not change between the analysis of the SWM and the real charged particle beam. The $\theta_{0,0}$ changes between the two scenarios and needs to be recomputed with each respective analysis.

b. Calculation of Z_{beam}

Applying the definition of Eq. 4-6 to the impulse current source in Eq. 2-3 reveals:

$$\phi_0=\frac{2\pi Z_o}{ika}\int_0^g \frac{I_o}{2\pi a}e^{-ikz}dz=\frac{Z_o I_o}{k^2a^2}\left(e^{-ikg}-1\right).$$

Since kg«1, ϕ_0 may be estimated as $\phi_0\approx\frac{-iZ_oI_og}{ka^2}$ since $e^{-ikg}\approx 1-ikg$ for kg«1. The formulae for calculating the elements of the matrix equation are found in Appendix D.

Using Eq. 4-4 to find $\xi_{0,0}$ is rather involved since it is required to find all of the cavity modes and their respective normalizations. At low frequency, however, the dominant mode of the cavity kernel is the DC mode described in Eq. 3-3. The effect of the DC mode on $\xi_{0,0}$ is:

$$\xi_{0,0\,DC}=4\pi^2\int_0^g\int_0^g dxdy\frac{1}{2\pi g\ln(\frac{b}{a})k^2a^2}=\frac{2\pi g}{\ln(\frac{b}{a})k^2a^2}.$$

WB5RVZ.Org - Softrock Lite II Builder Notes

Softrock Lite II Softrock Lite II: Mixer
Band:

Introduction

General Info About the Stage

From the builder's standpoint, the Mixer stage consists solely of the installation of the input resistors (R1 and R2) and the integrating capacitors, C5 and C6. The installation of the IC, U3, was performed in the Dividers Stage.

Theory of Operation

The RF input signal, filtered by the BPF is applied in antiphase to the inputs 1B and 2B of the Mixer U3.

The two LO signals from the Divider Stage operate the switches which connect R1 to C5 and connects R2 to C6 during the first clock cycle.

When the LO Clock changes 90 degrees later, the

connections reverse: R1 now connects to C6 (Q) and R2 connects to C5 (I).

This switching sequence then repeats itself.

The resulting RF input signal is sampled over capacitors C5 and C6 as the Intermediate Frequency (IF)

On the lower bands (160m, 80m, and 40m) the dividers are clocked at the desired center frequency, which is in the pass band for the incoming RF.

On the higher bands, the situation in the Softrocl RX is a little different. The clocking frequency is at the one-third sub harmonic of the desired center frequency and is NOT within the passband of the incoming RF.

For example, consider the 20m RX:

- For 20m, the dividers are clocked at about 18.73 MHz and their output QSD clock is 18.73 MHz / 4 = 4.682 MHz
- The third harmonic of that clock frequency is 3 * 4.682 = 14.047 MHz.
- The 20m signals in the BPF's passband will be sampled at that 3rd harmonic; however, the sampling will not yield as strong an I/Q pair as does the sampling technique used in the lower bands. Hence, the higher gain OpAmps for the higher band kits.
- It is like looking at a rotating wheel with a strobe flashing once for every three revolutions of the wheel. The rotation speed of the wheel is down converted but the image is not as bright as it would be if you flashed the strobe at the rotation speed of the wheel.

If you are interested, you might want to review the [illegible] operation. While the Softrock mixer is not a pure Tayloe mixer, the theoretical discussion on Taylo mixers helps with understanding how this process works.

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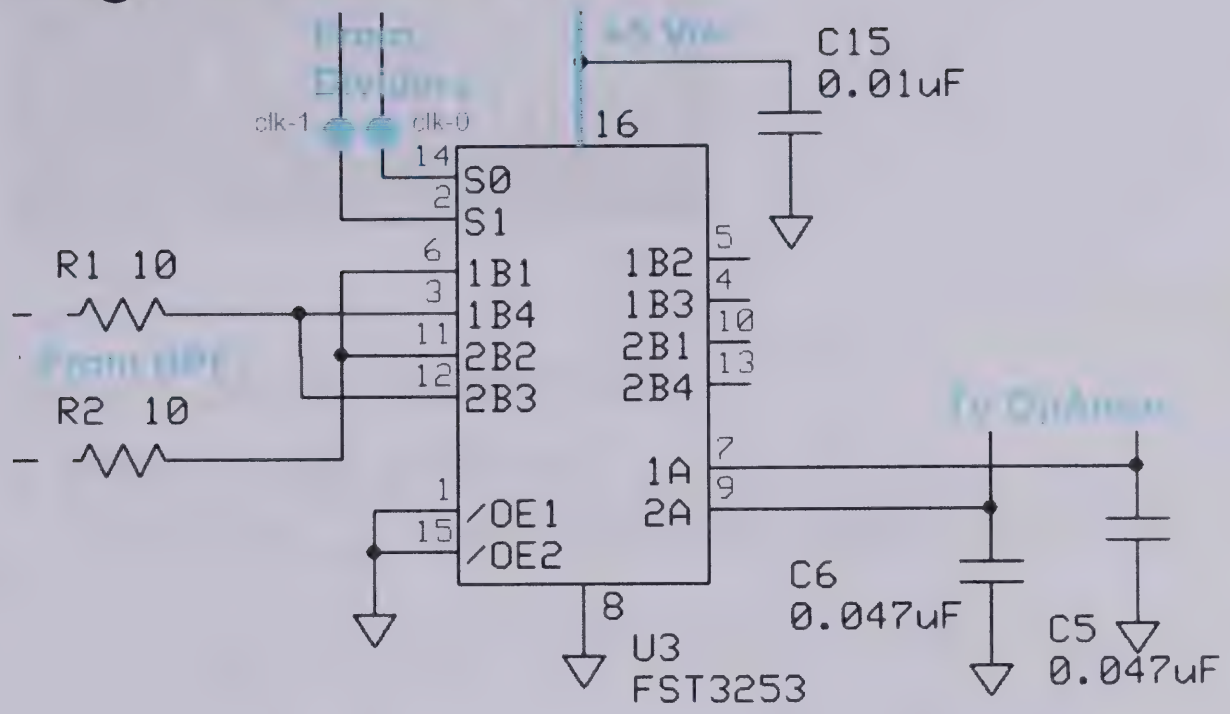
Stage Schematic



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Board Layouts

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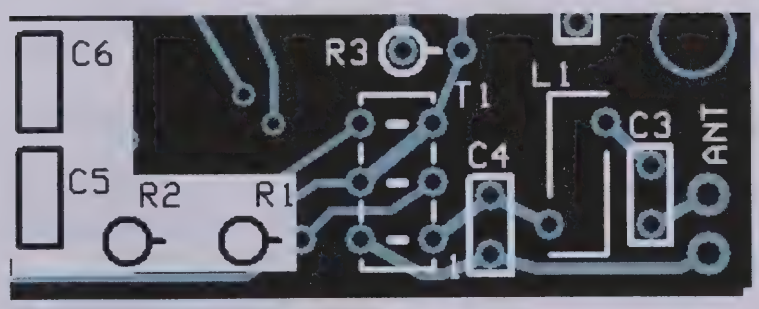

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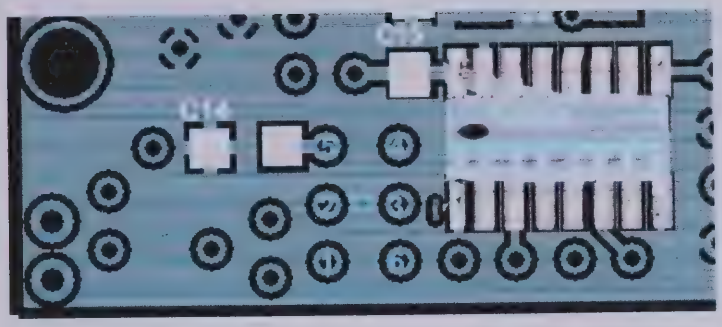
Board Bottom



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Mixer Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
☐	Capacitor	Ceramic	0.047 uF 5%	2	473	
☐	Resistor	1/4W	10 ohm 1/4W 1%	2	br-blk-blk-gld-br	

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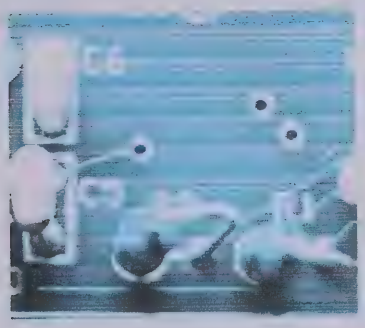
Detailed Build Steps

Install Topside Components



Install R1 and R2

See hints on orienting and installing resistors

Install integrating capacitors, C5 and C6

See hints on identifying and installing

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
☐	R01	10 ohm 1/4W 1% (top)	W-E	br-blk-blk-gld-br	
☐	R02	10 ohm 1/4W 1% (top)	W-E	br-blk-blk-gld-br	
☐	C05	0.047 uF 5% (top)	vert	473	
☐	C06	0.047 uF 5% (top)	vert	473	

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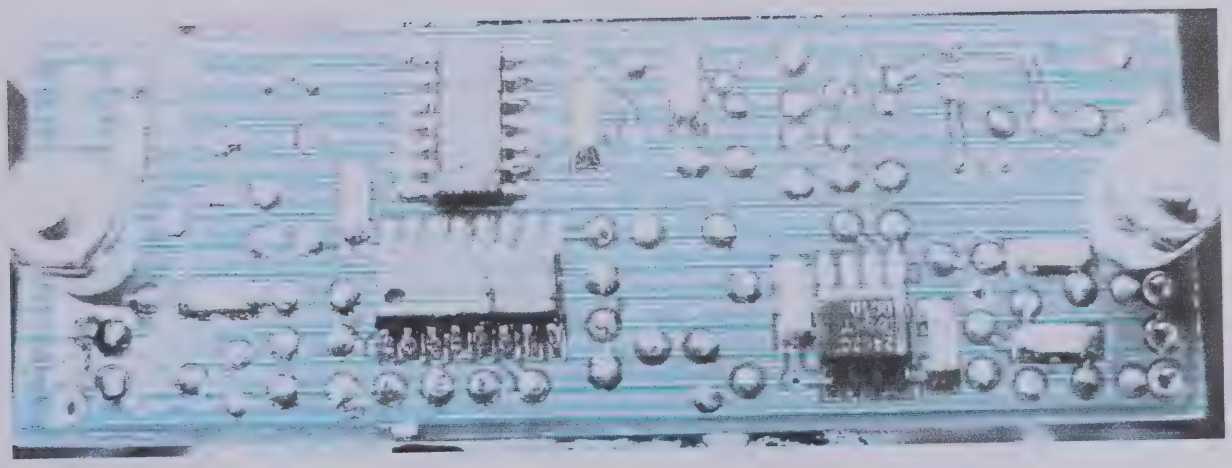
Completed Photos

Note: the completed pictures are of the 40m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside

View of Completed Underside



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Testing

Overview

Warning

Test Setup

Take appropriate ESD precautions in these tests, since you will be working around the very sensitive mixer IC

Visual Inspection

Test Setup

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the Mixer IC pins. If necessary, touch up the joints with your iron and/or some flux. Wick up any excess.

Current Draw

Test Setup

- In each test, the ammeter must be placed in series between the positive lead of the power source and the board's positive power-in "+" terminal.
- In one test there is also a 100 ohm resistor in the series "chain" as well.
- In the second test, the setup is the same except that the 100 ohm current-limiting resistor is removed.
- The mixer stage should not appreciably change the current draw from preceding stages.

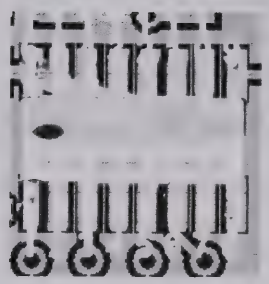
Apply 12 Vdc to the board for this test.

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
With the **100** ohm current limiting resistor	mA	< 30	26.1	_____
Without the current limiting resistor	mA	< 30	26.4	_____

Voltage Tests

Test Setup



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Pin 14 (QSD clk_0 on topside)	Vdc	2.5	2.47	_____
Pin 2 (QSD clk_1 on topsode)	Vdc	2.5	2.47	_____
Pins 3 & 12	Vdc	2.3 - 2.5	2.44	_____
Pins 6 & 11	Vdc	2.3 - 2.5	2.44	_____
Pin 7 (1A)	Vdc	2.3 - 2.5	2.44	_____
Pin 9 (2A)	Vdc	2.3 - 2.5	2.44	_____
Pin 16	Vdc	5	4.94	_____
Pin 8	Vdc	0	0	_____
Pins 1 & 15	Vdc	0	0	_____

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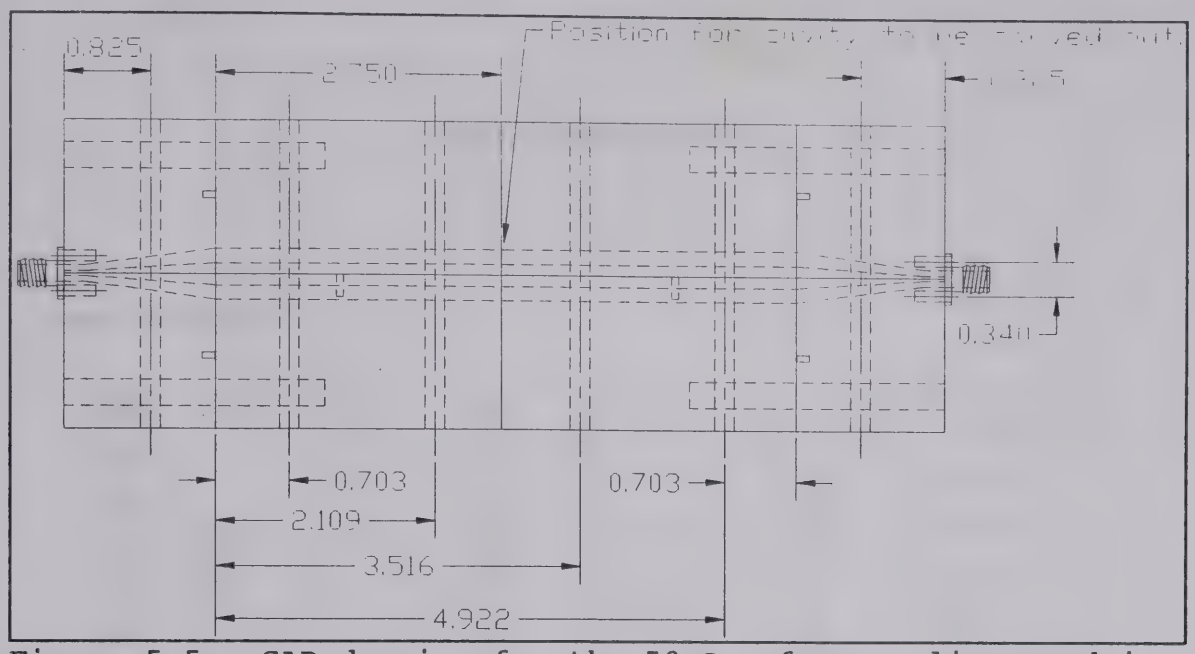

Figure 5-5. CAD drawing for the 50-Ω reference line used in the stretched wire measurement. All dimensions are in inches.

measurements.

The measurement results will be presented by first showing the frequency domain results from a network analyzer. Next, the results of a short impulse that was fed into the cavity will be presented and compared with the frequency domain measurements. Interpretations of the different measurement techniques on the beam impedance and wakefield will finally be presented.

ii. Network Analyzer Measurement Considerations

a. Reference Measurement

Before the cavity was carved into the structure, the scattering (s) parameters were measured to establish the reference measurement [16]. The stretched-wire measurement

SoftRock Lite II -- IF Application

Special Build Instructions

IF Frequency	Approximate SoftRock Lite II Center Frequency	Necessary Modifications
455kHz	464kHz	X1 = 1.856MHz C3 = 1500pF C4 = 0.047µF C10 = 1000pF C11 = 680pF C12 = 180pF L1 = 38T on FT37-61 core for 79µH T1 primary winding = 26T on T30-6 core for 2.4µH with bifilar secondary windings of 13T
4.915MHz (K2)	4.921MHz	Build as 40m Lite II, except: X1 = 19.6875MHz C3 = 220pF C4 = 3300pF C10 = 180pF C11 = 100pF
8.215MHz (K3)	8.192MHz	Build as 40m Lite II, except: X1 = 32.768MHz C3 = 68pF C4 = 1000pF
8.83MHz	8.812MHz	Build as 40m Lite II, except: X1 = 35.2512MHz C3 = 68pF C4 = 1000pF
9.0015MHz	8.985MHz (1/3 subharmonic sampled)	Build as 30m Lite II, except: X1 = 11.981MHz C3 = 100pF C4 = 1500pF
10.695MHz	10.707MHz (1/3 subharmonic sampled)	Build as 30m Lite II, except: X1 = 14.2764MHz
10.707MHz	10.724MHz (1/3 subharmonic sampled)	Build as 30m Lite II, except: X1 = 14.299MHz

WB5RVZ.ORG - Documentation Projects

Revisions/Errata for Softrock Lite II Project

(Use the menu tabs to return to your kit's home page)

Date	Stage(s)	Notes
1/9/2013	Home Local Oscillator Band Pass Filter	**Band-Specific Issue Is Now FIxed** Band-Specific Components are now implemented in the Biulls of Materials for all options (RX and IF) of the SR Lite II kit. Sheets 2 and 3 of the 9/3/2011 schematics on the

		that disagrees with the values from the schematic sheets on the Yahoo reflector. This should be resolved soon

		Yahoo reflector should NOT be used (other than as history).
1/8/2013	Local Oscillator Band Pass Filter	Received confirmation that the current valid list of band-specific components is the list on the FiveDash site. Currently in the process of updating the currently erroneous band-specific components for this project on the WB5RVZ.org site. Until further notice, builders should refer to the list on the FiveDash site. Apologies to any builders inconvenienced by this discrepancy.
1/7/2013	Local Oscillator Band Pass Filter	Added 7 new "bands" (for IF options) and specified band-specific components using 9/3/2011 Sheets 2 and 3 from Yahoo reflector for values. There is currently an issue with two different sets of value specifications. The FiveDash site has a set of values for the IF options

WB5RVZ.Org - Softrock Lite II Builder Notes

Softrock Lite II Softrock Lite II: Band Pass Filter Band:

Introduction

General Info About the Stage

Remember, when winding toroidal inductors, a single pass through the core counts as 1 turn. You might want to review [illegible] on winding toroidal coils and transformers.

Also, please refer to the common component mounting instructions fo toroids

Theory of Operation

The purpose of this stage is to pass the Radio Frequency signals within the receiver band to the mixer stage and to

attenuate unwanted signals which are not within the designed passband for the filter.

This attenuation is especially important, since it permits the 1/3 harmonic sampling in the mixer for the higher bands. Without that attenuation, for example, the 20m kit would be responding to signals in the region of 4.6825 MHz rather than to the designed response in the region of the 3rd harmonic of 14.0475 MHz!

For further information on the subharmonic sampling effect, refer to this topic on the Yahoo Reflector.

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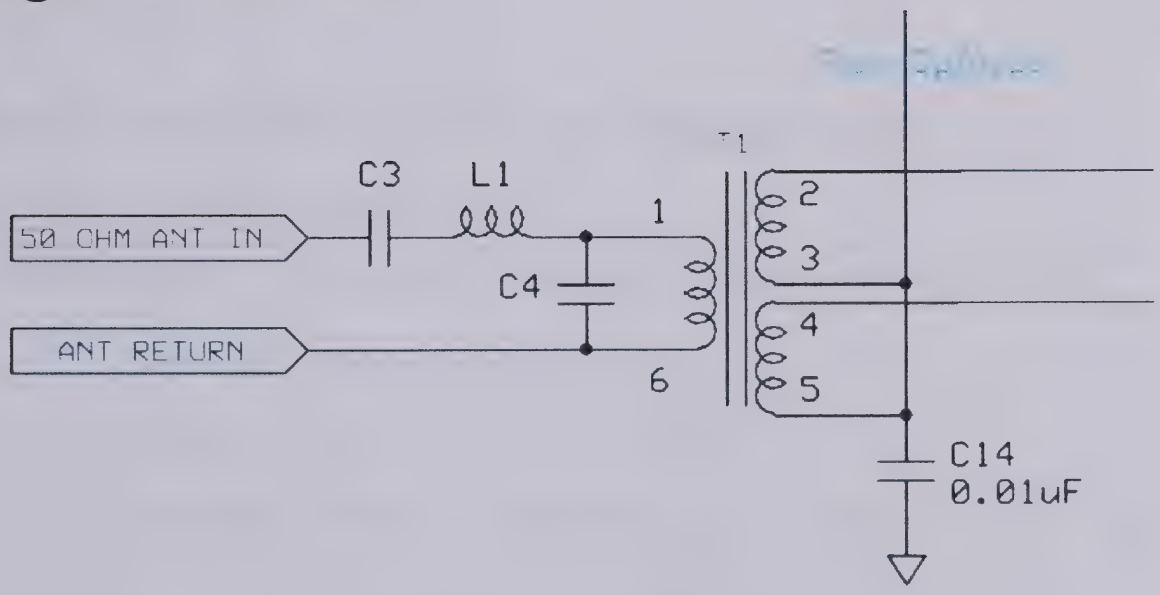
Stage Schematic



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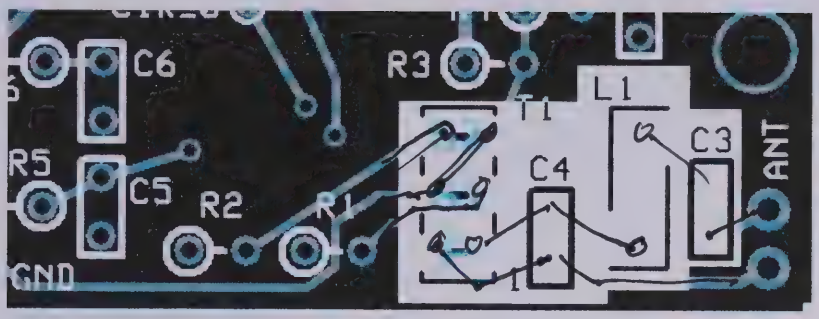
Board Layouts

Board Top



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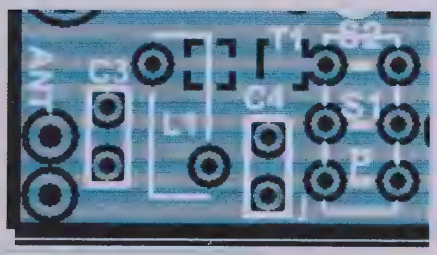
Board Bottom



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Band Pass Filter Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
☐	Capacitor	Ceramic	47 pF 5%	1	47J	
☐	Capacitor	Ceramic	680 pF 5%	1	681	
☐	Inductor	Toroid	[illegible]	2	yellow	
☐	Inductor	Xfrmr	[illegible]	1	yellow	

☐	Inductor	Coil	[illegible] #30 on T30-6 (yellow)	1	yellow	

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Detailed Build Steps

Install Band-specific Capacitors

Install the band-specific capacitors, C3 and C4.

See band-specific chart for values

See hints on identifying and installing Ceramic Capacitors

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
☐	C03	47 pF 5% (top)		47J	
☐	C04	680 pF 5% (top)		681	

Wind and Install Band-specific L1

Inductor Information

Common Techniques:

- One turn:
  - For toroids, one turn is a single pass through the center hole.
  - For binocular cores, one turn is a pass in which the wire goes in the bottom, comes out the top, goes back in the other hole at the top, and comes out the other hole at the bottom.
- Bi (tri) filar means 2(3) equal lengths of wire. You get the bi(tri)filar strand by taking the length of wire specified for the primary winding, folding it into half(thirds), twisting it to 3~ twists per inch, and winding it over the primary winding. One end of such a strand will have two(three) leads; the other end will have a "hairpin" bend (and a single lead in the case of tri-filar).
- Multi-filar windings are usually done AFTER the uni-filar winding is done.
- Windings shoud be evenly spaced and ideally made such that the winding covers ~345 degrees of the toroid
- Inductance values given are for the single (uni-filar) winding. They are provided to help verify turn counts and core material selected.
- Toroid nomenclature provides the outside diameter of the toroid (in hundredths of an inch - the "30" in "T30-2"), and material code (the "2" in "T30-2"). Color codes used in these kits are:
  - 2=Red
  - 3=Gray
  - 6=Yellow

- 7=White
- 10=Black
- 12=Green (with White on opposite side)

Inductors In This Step

L1

COIL: 2.5uH 26T #30 on T30-6 (yellow)
Using approximately 16 inches of #30 wire, wind 26 turns on a 0.30 inch od T30-6(yellow) ferrite. Inductance = 2.50 uH.

Install the band-specific coil, L1.

Also, please refer to the [illegible]

- **Do you Run Out of Toroid Before You Run Out of Turns?**

  Occasionally, you may find that there is not enough room on the toroid toplace all of the windings without having to go back and add a layer of winding. Tony Parks suggests that you overlap some turns as you put on windings around the circumference of the core so that all turns are on the core by the time you get back to the start end of the winding. This should have negligible effect on the coil's performance in the radio.

- **Coil Orientation**

  L1 is mounted vertically and supported by its leads.

- **Lead Preparation**

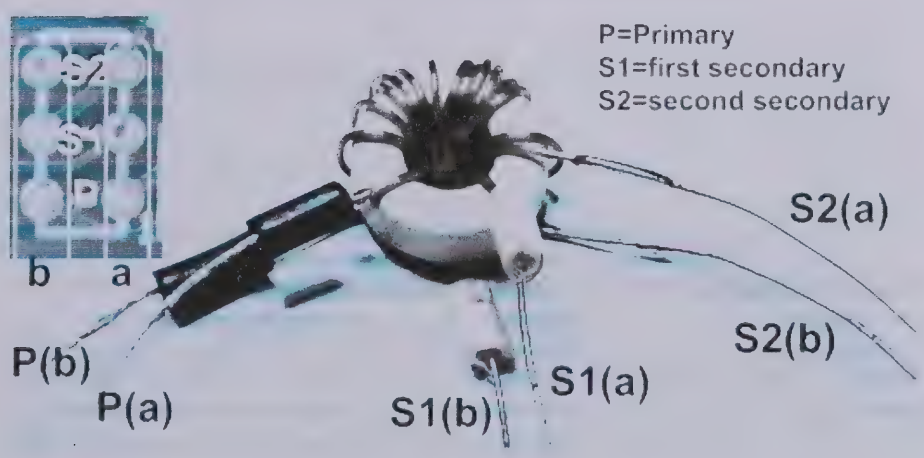
  Be sure to remove the enamel coating on the wire before attempting to solder an inductor lead to its associated mounting hole. There are two different approaches to removing the enamel and tinning the leads:
  - The enamel coating on the #30 wire provided in the kit does not heat strip very well but may be stripped by use of a small folded over piece of Emory paper where the lead is pulled through two

facing surfaces of the Emory paper multiple times to sand off the enamel coating on the wire end. Then you can run each lead through a blob of solder on the hot iron tip to tin it.

- If you have some solder flux (I use the paste kind), you can slather each lead with flux paste and then run each lead through a hot blob of solder to clean and tin the tip. You may have to repeat the process a couple of times to get all the gunk off of the lead. It produces a well-tinned lead with non of the trauma inherent in stripping the enamel with sandpaper or exacto knife.

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
☐	L1	2.5uH 26T #30 on T30-6 (yellow) (top)		yellow	2.5uH 26T #30 on T30-6 (yellow)
☐	L1-core	T30-6 toroid core (top)		yellow	

Wind and Install band-specific T1



Inductor Information

Common Techniques:

- One turn:
  - For toroids, one turn is a single pass through the center hole.
  - For binocular cores, one turn is a pass in which the wire goes in the bottom, comes out the top, goes back in the other hole at the top, and comes out the other hole at the bottom.
- Bi (tri) filar means 2(3) equal lengths of wire. You get the bi(tri)filar strand by taking the length of wire specified for the primary winding, folding it into half(thirds), twisting it to 3~ twists per inch, and winding it over the primary winding. One end of such a strand will have two(three) leads; the other end will have a "hairpin" bend (and a single lead in the case of tri-filar).
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- Windings shoud be evenly spaced and ideally made such that the winding covers ~345 degrees of the toroid
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  - 2=Red
  - 3=Gray
  - 6=Yellow
  - 7=White
  - 10=Black
  - 12=Green (with White on opposite side)

Inductors In This Step

T1

XFRMR: 0.18uH 8T/4T bifilar #30 on T30-6 (yellow)
Primary: Using approximately 8 inches of #30 wire, wind 8 turns on a 0.30 inch od T30-6 (yellow) ferrite.
Secondary: Using a total of 8 inches of #30 wire, wind 4 turns , bifilar, on the ferrite in the same direction as the primary winding. Inductance of the single winding (usually the primary) is 0.18 uH.

Also, please refer to the [illegible] and [illegible]. These resources should help the first-time transformer/coil builder past any concerns in that area.

- **Primary Winding**

- The primary winding is of the band-specific number of turns. Wind the primary winding with the specified number of turns of #30 AWG enameled wire so that the primary winding starts and ends at about the same point on the core and is uniformly spread around the core.

- **Secondary Windings**

  The secondary uses lengths of #30 wire, twisted together into a bifilar pair that has approximately 2-3 twists per inch and is wound over the primary, using the band-specific number of turns.Wind the secondary windings, in the same direction as the primary, with the windings starting and ending just slightly clockwise around the core from where the primary winding starts and ends.

- **ID and Tag the Winding Leads**

  After striping and tinning each transformer lead at about 1/8 of an inch from the core, determine the two pairs of leads of each of the secondary windings by use of an ohmmeter. I like to use short lengths of insulation from hookup wire to identify two of the 3 sets of leads in these transformers.

- **Transformer Orientation**

  (Refer to the graphic, above): Correct wiring is with leads from one side (the "a" side) of the core going to a group of three holes and the leads from the other side (the "b" side) of the core going to the other group of three holes as shown below.
- Note the photo above shows the holes for the primary ("P") and each of the two secondary ("S") leads, with the "a" and "b" designating

from which side of the core the particular winding's lead should go.

- for example:
  - The primary winding's "b" lead would go into the left-hand "P" hole
  - The primary winding's "a" lead would go into the right-hand "P" hole
  - The first secondary winding's "b" lead would go into the left-hand "S" hole in the middle row of winding holes
  - The first secondary winding's "a" lead would go into the right-hand "S" hole in the middle row of winding holes
  - and so on ...
- Be careful when threading the leads through the holes to avoid their getting tangled up with nearby components!

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
☐	T1	0.18uH 8T/4T bifilar #30 on T30-6 (yellow) (top)		yellow	0.18uH 8T/4T bifilar #30 on T30-6 (yellow)
☐	T1-core	T30-6 toroid core (top)		yellow	

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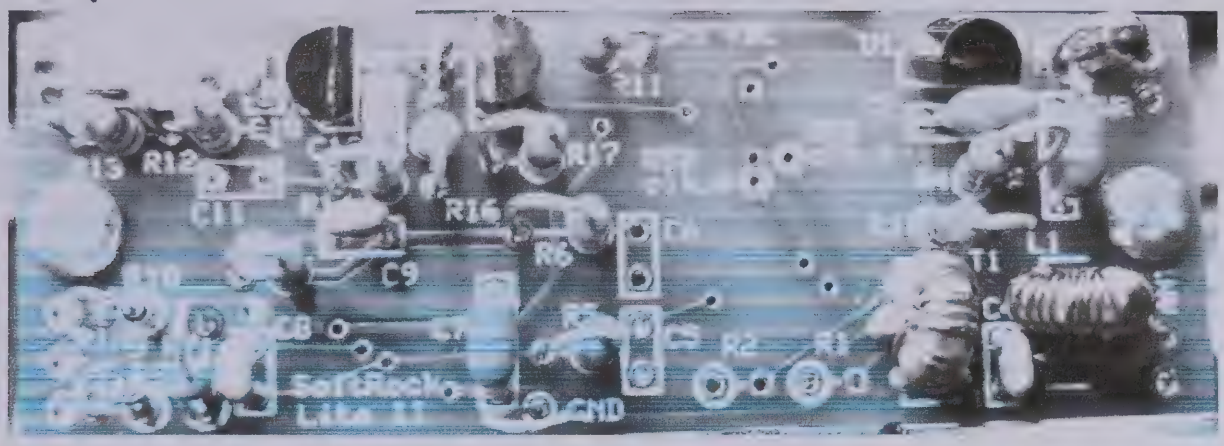
Completed Photos

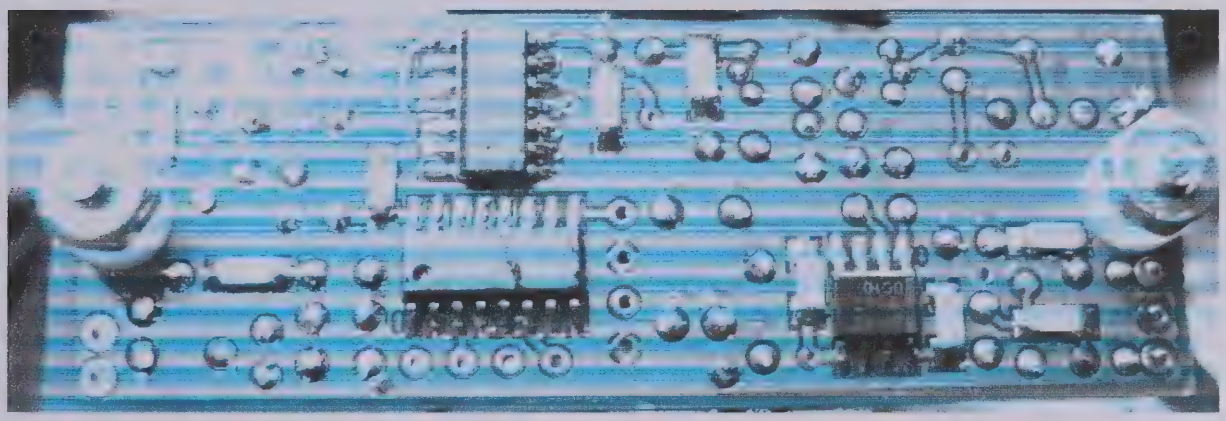
Note: the completed pictures are of the 40m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside

top side



View of Completed Underside



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Testing

Overview

Visual Check

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor conducts.

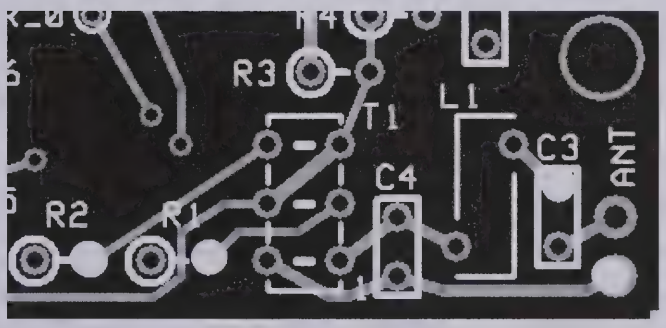
Pay especial attention to the joints on the transformer. Bad solder joints in this stage will have an extreme effect on the sensitivity of the receiver.

Inductor Continuity Tests (NO power)

Test Setup

This tests the continuity through L1 and the T1 primary winding, using testpoints (red dot with letter "P") that test the continuity from connected pads. This helps check the soldering of the leads by placing the probes at points that are connected to the actual solder joint.

Similarly, the secondary windings of T1 are tested for continuity, using the secondary testpoints (red dots with the letter "S").



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Point "P" to point "P"	ohm	0	0	_____
Point "S" to point "S"	ohm	0	0	_____

Voltage Tests

Test Setup

Apply power and measure the voltages WRT (with respect to ground).

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
R1 hairpin (hole)	Vdc	~2.5	2.47	_____
R2 hairpin (hole)	Vdc	~2.5	2.47	_____

Resistance Tests (no power)

Test Setup

Remove power from the board and measure the resistance with respect to ground for the T1 secondaries in-situ.

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
R1 hairpin (hole)	ohms	~800	803	_____
R2 hairpin (hole)	ohms	~800	803	_____

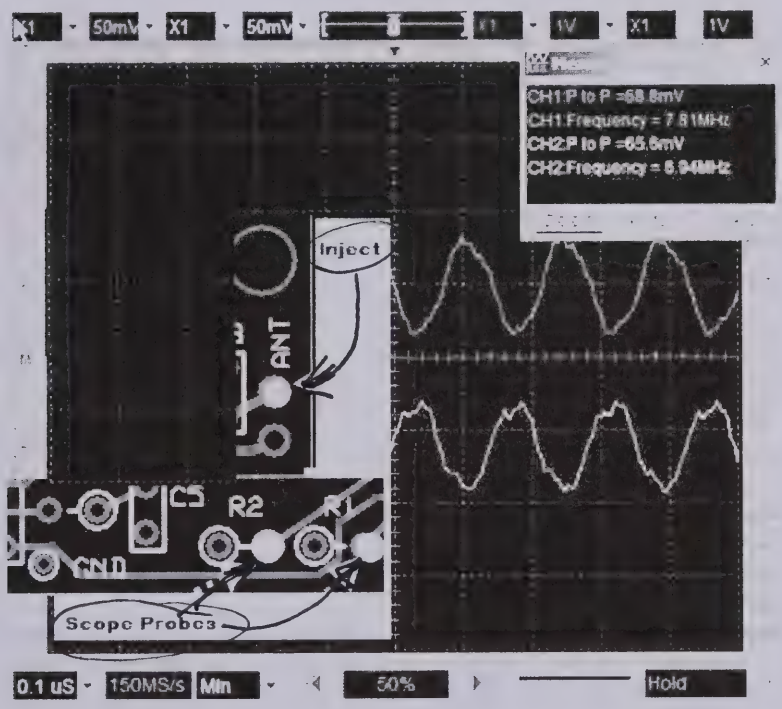
Phasing Test (NO power)

Test Setup

Optional Test - assuming you have a dual channel scope and an RF source that can output a signal close to PW and specific center frequency.

- Conduct this test with the power OFF
- Connect a ~2 volt p-p signal source at around the center frequency into the ANT-IN and RET pads.
- Set up the scope for triggering on Channel 1

- Connect the scope probes to the R1 and R2 hairpins (holes) and the ground clips to ground.
- You should have a pair of equal amplitude, opposite phase signals displayed. If they are in phase, you probably aren't triggering the scope on channel 1. If either one is missing, double check the solder connections for T1.
- Thanks to Leonard KL0WOX for this test



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WB5RVZ.Org - Softrock Lite II Builder Notes

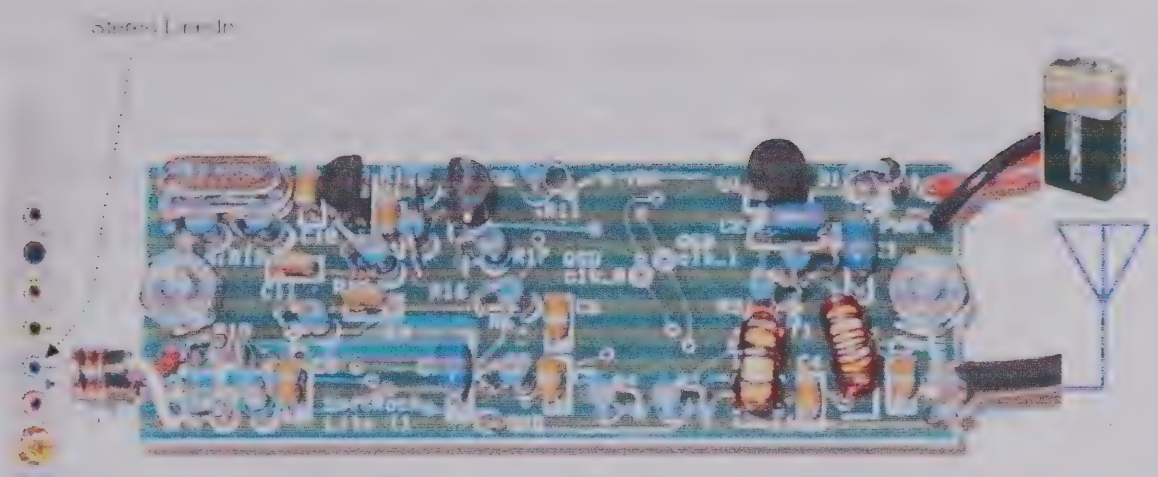
Softrock Lite II Softrock Lite II: External Connections Band: 20m

Introduction

General Info About the Stage

The final stage involves connecting the RX to the outside world. Specifically, we need to provide for:

- Power - the power leads can connect to a well filtered, regulated DC source fromn 9 to 13 Vdc.
- RF - need to connect the antenna and antenna return terminals to a 50 ohm antenna tuned for the specified band
- I/Q Output - connect the I and Q audio outputs of the RX into the PC via the stereo input of its sound-card. Normally, this will connect to the stereo "line-in" jack; depending upon the PC/Laptop, you might need to use the stereo "MIC" jack.



Ground Loops

If your display shows numerous peaks/spikes up and down the spectrum, these are likely caused by ground loops (since the spectrum is a display of I and Q signals in the audio/near-audio range).

Doug, WA3DSP, advises:

The SoftRock boards have a number of places where you could create a ground loop. The antenna should not be one of them as long as you isolate BOTH sides of the connection. In other words do not use a shell grounded BNC or other coax fitting on a metal chassis. I use an isolated shell BNC. The power connection is another place where a ground loop could take place. Of course running on a battery would eliminate that as would powering from a wall transformer.

The only two things left are the audio connections and the USB connection, if you use it. Both are grounded at the computer so in most cases a ground loop would not happen here.

So first make sure you antenna and power to the Softrock card are isolated. You don't need USB to receive so you could disconnect that. Then you would only have one grounded connection to the card and if you are still having problems it might be something else.

Alan, G4ZFQ, puts it this way:

"Ground loop" says it all. The RX must be connected to the computer by just one ground. The PSU is a common reason, somtimes the antenna. There is no

measurements require a formula to relate the scattering parameters back to the beam impedance Z_{beam}. The derivation of this relationship requires assumptions:

- $k \triangleq \frac{\omega}{c}$, a frequently used definition for wave number used throughout this dissertation.
- $ka \ll 1$, an implication that the frequency of interest if far below the first TM cutoff frequency of the beampipe. This assumption allows an additional assumption that $E_z(r=a,z) \approx E_z(r=0,z)$.
- $kg \ll 1$, an assumption that the z dependance of $E_z(r,z)$ is constant. (i.e. $E_z(r=a,z) = \gamma_0$, where γ_0 is a constant.) The requirement of $kg \ll 1$ may be relaxed, for example, by demanding that

$$E_z(r=a,z) \triangleq f(z) = \sum_{l=-1}^{l=1} \gamma_l e^{i\frac{2l\pi z}{g}} .$$

  Using this assumption, however, changes the proceeding results. Allowing higher dimensions in the estimate of $E_z(r,z)$ allow a more rigorous and broadband estimate of both circuit and beam impedances.
- impulse source distribution defined in Eq. 2-3.
- $k(b-a) \to 0$ assumes that the size of the discontinuity is small with respect to a wavelength.

Since $E_z(r,z)$ is assumed to be a constant function of z, Eq. 4-7 changes into a simple linear equation of one equation

simple answer, as you indicate, different setups seem to have different answers. It should be posssible to greatly reduce the problem but experimenting is the only real answer. Check what is grounded and try disconnecting duplicated ones. Multiple connectionas between the SDR and computer may be acceptable if they are run together. Bad audio cables picking up external noise is another thing to look for.

Theory of Operation

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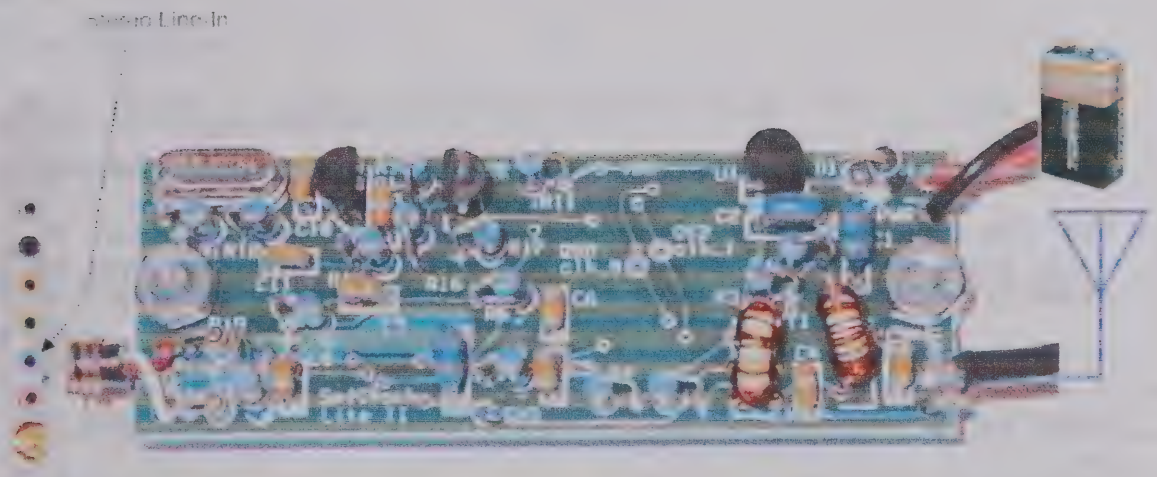
Stage Schematic



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Board Layouts

Board Top

show that the cavity stores energy in its modes at both $\omega=0$ and $\omega=2\pi$. Each of the pipe kernels has the property that a particular pipe mode behaves strongly in the frequencies near the vicinity of the cutoff frequency of each pipe mode. Additionally, each propagating pipe mode decays as

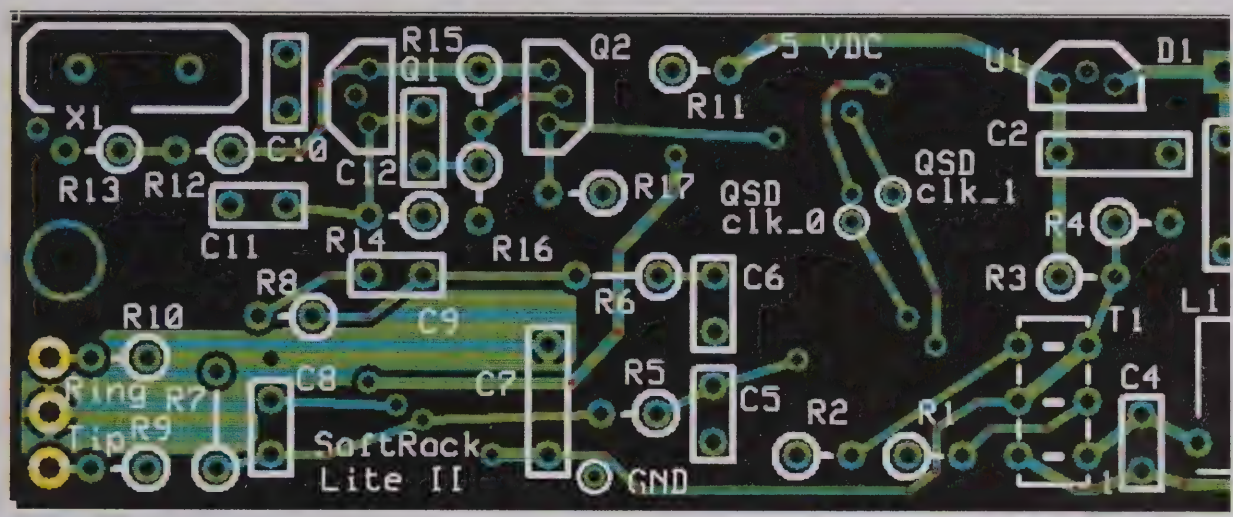
$$\frac{c}{\omega a}\left(1-\left(\frac{j_s c}{2\omega a}\right)^2\right)$$

with $\omega \gg \omega_{cutoff}$ for each respective pipe mode s. Since the first dominant mode for the center conductor pipe kernel is the TEM mode and its cutoff frequency is $\omega_0=i_0=0$, the effective coupling of the TEM pipe mode is inversely proportional to frequency. The dominant propagating pipe mode for a particular bandwidth B contributes the most to the loss mechanism for all the cavity modes with resonances contained within B. Therefore, if frequency is high enough such that the TEM mode is sufficiently decayed out of the pipe kernel, and if a TM pipe mode exists whose cutoff frequency passes through a cavity mode by the introduction of the wire, then the cavity mode will have an artificially higher Q in the presence of the wire.

vi. Example of a Relationship between SWM Impedance to Beam Impedance

a. Introduction

The use of network analyzers to perform stretched wire



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Board Bottom

07_extconn stage underside

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External Connections Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
☐	Cable	Cable, antenna	antenna COAX	1		
☐	Cable	Cable, Audio	Stereo Audio Shld Cable, single 1/8" plug	1		
☐	connector	Cable	power leads	1		

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Detailed Build Steps

Install Power Connection

regime where the TEM pipe mode is dominant over the lowest cutoff frequency beampipe mode. Figure 5-2 is a contrived example which demonstrates this phenomenon. Figure 5-2 is a relative plot of the magnitude of the open beampipe kernel (Eq. 1-6) and the center conductor beampipe kernel (Eq. 1-8) for a particular value of z=z'=0. The cavity energy storage is an integration of the electric and magnetic fields in the region {0≤r≤b; 0≤z≤g} and has units of Joules. In Fig. 5-2 it is assumed that the shift in cavity resonant frequency caused by the introduction of the wire is negligible with respect to the shift in the first TM cutoff frequency of the beampipe. The strong peaks in the cavity plot of Fig. 5-2

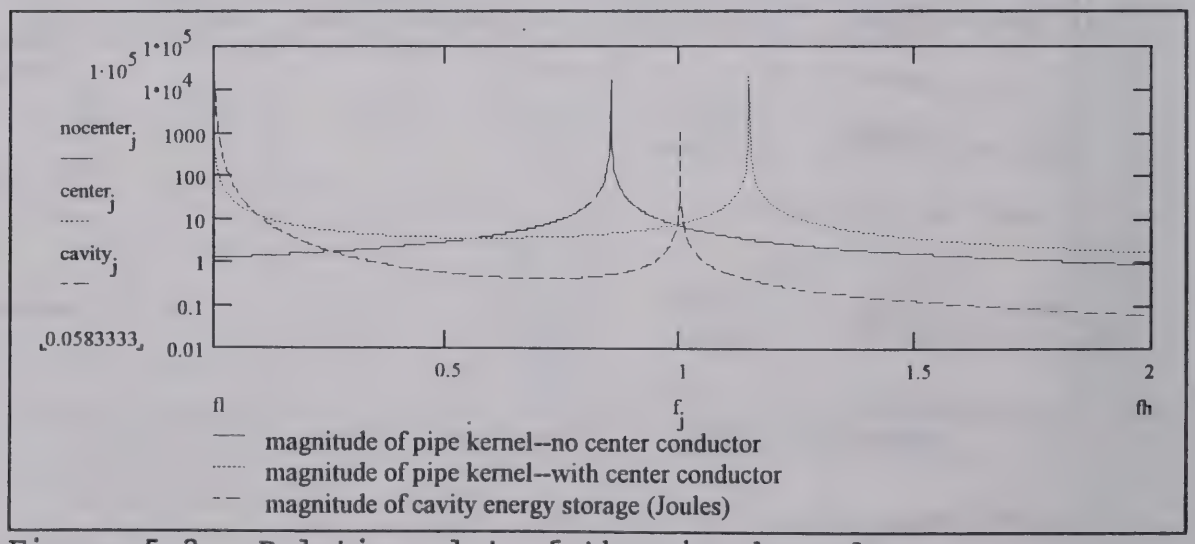


Figure 5-2. Relative plot of the pipe kernels (dimensionless) and cavity energy storage (Joules) versus normalized frequency. Note the shift in cutoff frequency between the open beampipe and the beampipe with the center conductor. Between the cutoff frequencies is a cavity mode, which would have an artificially higher Q with the center wire present.

Install the power leads (nominally red for positive and black for negative) to the PWR + and PWR - holes on the upper right-hand side of the board

Use the power jack or plug appropriate to your situation

If at all possible, when initially testing the rig, it would be a good idea to use a battery or gel cell for the power supply. This minimizes the potential (pun intended) for ground loops (see discussion in Introduction section above). Later, you can introduce a mains-powered supply and, if that introduces ground loops, then you can make decisions from that point.

Check	Designation	Component (top/bottom)	Orientation	Marking	Image	Band
☐	pwr	power leads (top)				any

Install I/Q Audio Cable Connection

Cable

A stereo audio cable may be connected at this time to the board at the three

energy. The evanescent pipe fields can be, to first order, taken into consideration by allowing the unperturbed cavity fields to evanesce into the pipe [13]. The effect of propagating pipe modes and its coupling to cavity modes are not as easily estimated and general conclusions cannot be easily drawn.

This definition for the impedance is not necessarily useful. The presence of the wire shorts out the accelerating electric field. The off-axis electric field is thereby attenuated several orders of magnitude. This term will not be used or discussed in the remaining portions of this dissertation.

v. Beampipe Cutoff Frequency Change

Adding the center conductor has the effect of changing the TM cutoff frequencies of the beam pipe. Note that the cutoff frequencies for each TM pipe mode always increase with the addition of a center conductor. If the addition of the center conductor causes the cutoff frequency of a beampipe mode to shift such that a dominant cavity mode couples energy into an evanescent pipe mode rather than a propagating pipe mode, then the stretched wire measurement may show an artificially higher Q than what is witnessed with a charged particle beam. In the same way, the addition of the center conductor can cause the Q of cavity modes to appear artificially low if the cavity modes occur in a frequency

plated through-holes along the lower left edge of the board near the lower left corner.

- **Strain Relief**

  Use a short piece of #22 bus wire to connect the middle plated through-hole (ground) to the shield (barrel) of the cable and wrap the end of the bus wire around the outside of the cable several turns for strain relief of the cable.

- **Cable Installation**

  - **Notefor the 30m. 20m, and 15m RX kits**

    1/3 sub-harmonic sampling does reverse the spectrum. Changing the audio cable connections to the SoftRock Lite circuit board from tip to ring and ring to tip will correct the reversed spectrum so that the SDR software works the same for the higher band receivers as with the lower band receivers.
  - For the lower band units, the tip of the stereo cable plug connects to the plated through-hole that is marked "Tip" on the board. It is the "I" signal. Reverse this for the higher band units.
  - For the lower band units, the ring of the stereo cable plug connects to the plated through-hole marked "Ring" and is the "Q" signal. Reverse this for the higher band units.

Alternate Connection - Stereo Jack

Some builders might prefer to implement the I/Q Audio connection using a 1/8" stereo mini-jack instead of a stereo cable terminated with a 1/8" stereo plug. Either approach works and is pretty much up to the individual builder and his/her approach to packaging the finished board.

Troubleshooting Large differences in I and Q Output

The receiver should provide nearly identical I and Q signals (other than phase). If there are significant differences in the gain of each OpAmp output, you may want to look at the following before concluding that the IC is bad:

Things that could affect gain--

1. The feedback resistors (R7 and R8) are poorly soldered or of the wrong

occurs above the cutoff frequency of the open beampipe.

iv. Change in Definition of the Beam Impedance

An obvious difference with the presence of the wire is the required change in the definition of beam impedance. The mere existence of the wire on axis requires the wakefield to identically vanish. It has been proposed that the fields are only locally disturbed by the presence of the wire and a similar wakefield type quantity may be defined by shifting the location of the definition for the wakefield to a position off-axis. Arbitrarily, it is chosen to define a new path of integration for defining the wakefield from Fig. 1-1 to a path along the wall of the beampipe. The modified definition for the beam impedance from Appendix A is then:

$$\tilde{Z}_{beam}(\omega) \triangleq -\frac{1}{q}\int_0^g E_z(r=a,z,\omega)\, e^{ikz}\, dz,$$

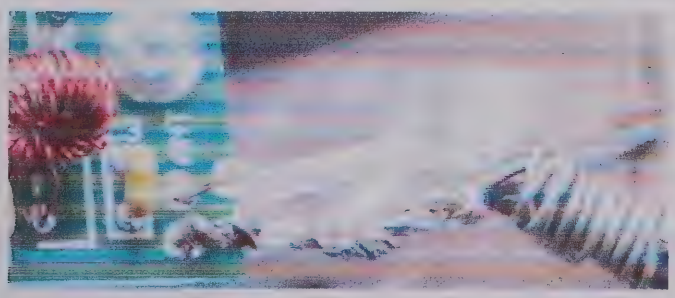
where $E_z(r=a,z,\omega)$ is computed with a complex Fourier series along the interval $\{0 \le z \le g\}$. Examination of the limits of the integration in this new definition implies that the contribution to the wakefield exists only at the specific location of the cavity. The inability for both the propagating and evanescent pipe modes to interact with the beam outside of $\{0 \le z \le g\}$ is a nonphysical assumption. It has been shown with stretched wire measurements that the evanescent pipe fields of a cavity mode contain significant

value(s)
2. Incorrectly wound transformer in the BPF.
3. Incorrect resistors (10 ohm) at both the input and output of the QSD.
4. Incorrect filter capacitor(s) on the output of the QSD.

(tx to Milt W8NUE)

Check	Designation	Component (top/bottom)	Orientation	Marking	Image
☐	audio	Stereo Audio Shld Cable, single 1/8" plug (top)			

Install Antenna Connection



- **Antenna Impedance**

  It is extremely important to use an antenna with as close a match as possible to 50 ohms impedance. The radio's sensitivity is predicated on a 50 ohm antenna input.

- **Coax**

  Connect a length of 50 ohm coax to the antenna connection on the right edge of the board near the lower right corner. RG-174 is a good fit for this tiny board.
  - The lower of the two plated through-holes is the antenna RTN connection to the coax shield
  - The upper plated through-hole is the coax center conductor connection (ANT IN).

individually calculated in the summation of the pipe kernel. Consequently, the *minimum* point of truncation must be large enough such that α_s remains relatively constant. The final 180 α_s, however, appear to converge to the bound. The error in the estimate of the truncation error is minimized therefore by choosing the point of truncation to be: 1) large enough to include several evanescent modes and all propagating modes and 2) large enough such that the α_s has settled to a point where an estimate of it can be adequately made.

iii. Addition of a Loss Mechanism and Data Modification

The presence of the wire may reduce the numerics of the computation because the wire adds an effective loss mechanism to all of the cavity modes. The loss mechanism is a consequence of the TEM pipe mode and its ability to carry stored energy out of otherwise loss-less cavity modes. A loss mechanism was discussed in Ch. IV, Figs. 4-1 and 4-2, as a numerical necessity for the existence of a causal inverse Fourier transform of the beam impedance. The additional loss mechanism reduces the post-computation work since the computed data will be causal and therefore does not require the changes that the computation depicted in Fig. 4-1 suffers. No computational savings will be experienced, however, between the open beampipe and the center conductor beampipe if the resonant frequency of the first cavity mode

- **Not Grounded!**

  Note that this connection is isolated from circuit ground.

You may want to review the series of messages on this subJect in the Softrock 40 Yahoo Group.

Additionally, you should review the materials on the Clifton Labs website concerning the use of an antenna isolation transformer

Finally, regarding the "floating antenna RET" connection, review the messages in this topic where the builder was getting no signal and the cause was the improper ANT RET connection.

Check	Designation	Component (top/bottom)	Orientation	Marking	Image	E
☐	ant	antenna COAX (top)				a

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Completed Photos

View of Completed Topside

View of Completed Underside

07_extconn stage completed underside

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As $s \to \infty$, α_s does not have a formal limit. To estimate the truncation error of the center conductor pipe matrix requires an estimate of α_s for large s. The propagating pipe modes and the lowest order evanescent modes make the largest contribution to the pipe kernel. Examining α_s for large s shows that a bound for α_s exists and is:

$$\alpha_s \le \alpha = \frac{a}{a - r_o}.$$

Replacing α_s by α introduces error to the estimate of the pipe kernel. To reduce the error from the introduction of α, the point of truncation for the series in Eqs. D-1 and D-2 must be sufficiently high such that the leftover series uses the estimate of α. The truncated sum must be much greater than the leftover sum.

Figure 5-1 is a plot of α_s versus s for a 50-Ω coaxial beampipe. Calculating the limiting value α for the 50-Ω geometry shows α=1.769. For a 50-Ω geometry, the first 15-20 α_s fail the assumption that $i_s \frac{r_o}{a} \gg 1$ and these first 15-20 terms must be

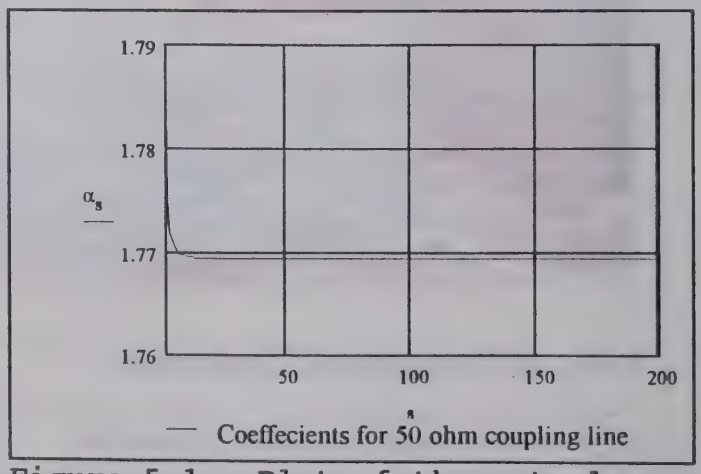


Figure 5-1. Plot of the actual α_s for a 50-Ω coupling line.

Testing

Overview

Final Test

Test Setup

Once external connections are installed, you are ready to take the radio for a spin. This final test will use Rocky as the SDR Software.

For further discussions of the software side of SDR and soundcard issues, see Alan G4ZFQ's pages

This test assumes you have the following:

- A Windows Computer on which Rocky has been installed. Note: in Windows Vista, Rocky cannot "see" the on-board soundcard; Rocky can, however, "see" any external USB soundcard connected to a Vista computer.
- A sound card with a stereo input ("mic" or "Line-In") Note: some laptops, unfortunately, lack a true stereo input connection (either no line-in jack or just a "mic" that is mono only).
- An antenna (the better the impedance match to 50 ohms, the better the reception)

Setup the Radio and the PC

- Plug the audio output cable into the "mic" or "Line-In" input on the PC's sound card.
- Connect the antenna cable to your antenna (you can use a simple wire antenna, but the reception will be poor).
- Run the Rocky SDR program
- Select your soundcard in Rocky (`view -> Settings -> (click on the "Audio" tab)`)
  Normally, you will have a single soundcard, your on-board card, and that will be the default setting for both the "I/Q Input Device" and the "Audio Output Device". The default sampling rate is 48 kHz (you should be so lucky to have a card that samples at 96 kHz!)

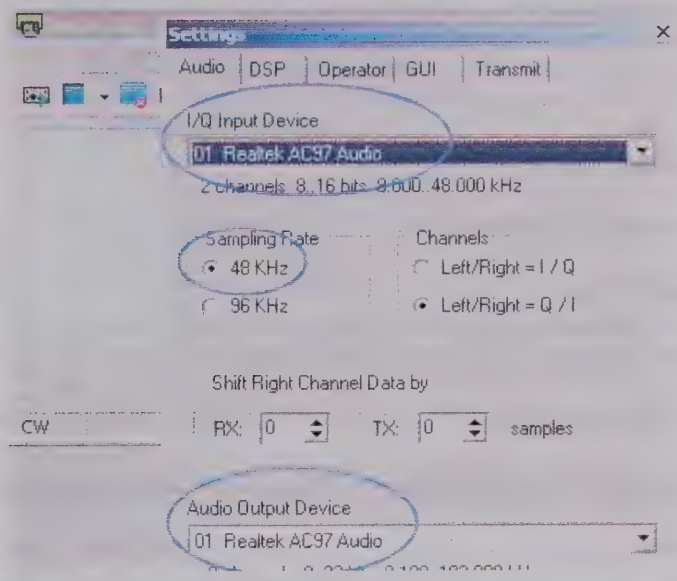
the beampipe. Finally, the addition of the center conductor introduces a set of coefficients in the definition of the center conductor pipe kernel in Eq. 1-8. Each coefficient in Eq. 1-9 dictates a different level of coupling from the waveguide pipe modes to the cavity modes than what was observed in the open beampipe. In fact, the coupling from the beampipe to each cavity mode is stronger for the center conductor beampipe than for the open beampipe.

Estimating the coupling coefficients for asymptotic calculations was performed by first finding the cutoff frequencies of the center conductor beampipe from the equation:

$$J_0(i_s)\,Y_0\left(i_s\frac{r_o}{a}\right)=J_0\left(i_s\frac{r_o}{a}\right)Y_0(i_s)\,.$$

When $i_s \gg 1$ and $i_s\frac{r_o}{a} \gg 1$, the asymptotic forms of the Bessel functions were used to find:

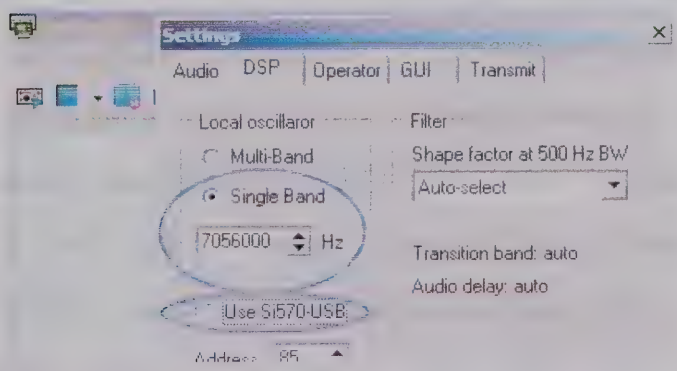
$$i_s \approx \frac{s\pi}{1-\frac{r_o}{a}}, \qquad \alpha_s=\frac{J_0^2\left(i_s\frac{r_o}{a}\right)}{J_0^2\left(i_s\frac{r_o}{a}\right)-J_0^2(i_s)} \approx \frac{1}{1-\frac{r_o}{a}\dfrac{\cos^2\left(\frac{s\pi a}{a-r_o}-\frac{\pi}{4}\right)}{\cos^2\left(\frac{s\pi r_o}{a-r_o}-\frac{\pi}{4}\right)}}\,.$$



- Set Rocky/s center frequency to the value (in Hz) corresponding to your kit:
  - 160m: 1.8432 MHz (1843200 Hz)
  - 80m: 3.522 MHz (3522250 Hz)
  - 40m: 7.056 MHz (7056000 Hz)
  - 30m: 10.125 MHz (10125000 Hz)
  - 20m: 14.0475 MHz (14047500 Hz)
  - 15m: 21.045 MHz (21045000 Hz)

  Enter the appropriate center frequency in Hz(`View -> Settings -> (click on the "DSP" tab)`)

  Example, here, uses 40m rig's center frequency of 7.056 MHz:



It's alive, alive I tell you!

- Apply power to the receiver
- If not already done, Run Rocky and start the Rocky

V. Stretched Wire Analysis

A. Theoretical Solution.

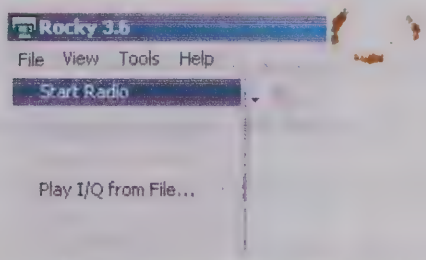
i. Introduction.

The solution to the problem in Fig. 1-9 with a center conductor of radius $r=r_o$ is estimated using the same complex Fourier series techniques used to solve the open beampipe geometry and current sources described in Ch. IV. Since the general method of solving Eq. 1-12 is identical to the charged particle beam, a discussion of the differences and changes in estimating the solution of Eq. 1-12 for the geometry with the center conductor will be presented.

ii. Change in Pipe Kernel Definition and Cavity Coupling

The first difference between the stretched wire measurement and a physical beam is the obvious change in geometry and boundary conditions caused by the introduction of the center conductor. Mathematically, this changes the definition of the pipe kernel in the analysis of Eq. 1-12 and Eq. 1-8 must be used for the pipe kernel rather than Eq. 1-6. The additional coefficient terms of Eq. 1-8 (the α_s in Eq. 1-9) describe the differences in coupling between the cavity modes of either the open beampipe or the center conductor beampipe. Physically, adding the center conductor has three fundamental effects. First, it allows energy to couple into and out of the cavity via the TEM pipe mode. Secondly, it shifts the cutoff frequencies of the TM waveguide modes of

(File > Start Radio - click on "Start Radio")



You should see something like the following on the Rocky screen (depending upon your antenna, band conditions, and time of day):

View of Rocky Spectrum Centered on 7.056 MHz

If you see an unwanted "mirror image" of the desired signal, you may want to check out the image rejection hints on this website.

Go to Top of Page

not it is necessary to modify the resulting beam impedance data. The modification method presented in this chapter applies only to pillbox modes which are coupled strongly to the particle beam. It is necessary to consider practical current source geometries in the analysis since an impulse of current has infinite bandwidth.

winding; "a" is one side of the toroid, "b" is the opposite side)

- The two leads for the 2nd secondary winding, "S2a" and "S2b" ("S2" stands for the 2nd secondary winding; "a" is one side of the toroid, "b" is the opposite side)

To mount the transformer you insert the leads into the holes annotated on the board as "P", "S1", and "S2". The holes may also be annotated as to the "row" ("a" row or "b" row) which corresponds to the leads on the "a" side or the "b" side of the toroid.

the builder should start with the single winding, inserting its two leads into the appropriate holes and then do the same with the first of the two bifilar windings, and finally do the same with the second of the two bifilar windings

After inserting the leads, the builder should pull each lead pair through the holesuntil the transformer is snug to the board. Soldering the leads completes the process.

Leonard, KC0WOX, has an excellent (large - 100+ Mb!) video showing the
on an earlier Softrock (transceiver) kit. He also has a 2 minute video clarifying

Binocular Transformers

Binocular cores

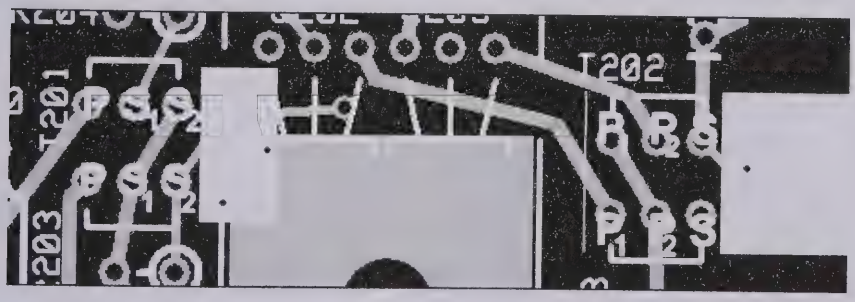
Winding and Installing transformers on binocular cores is a hard process to clearly describe. There are two aspects to it.

- One is the actual winding of the coil. Bino cores can be wound either:
  - with all leads coming out of the same end or
  - with some leads coming out of one end and some coming out of the other.
- All Tony's kits - so far - have used the winding convention where all windings come out of one end

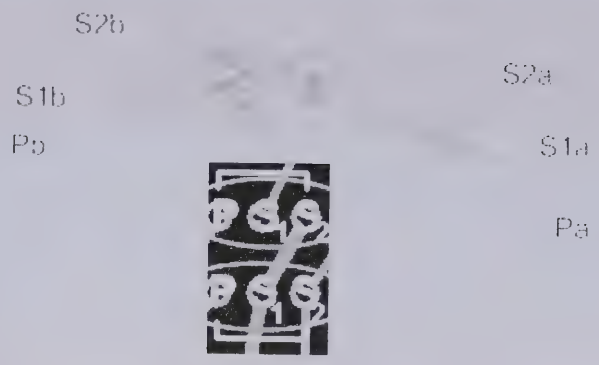
of the binocular core, with one turn counted each time the wire goes in one hole and comes out the other, at the same end (see below).

One Turn

- The other aspect is the correct polarity. That is a little easier, since Tony has designed the boards such that the polarity is pretty well handled for you.
  - The key is to start each winding in the same hole of the bino core and end each winding in the other hole (on the same end of the core).
  - When you finish winding the typical bino transformer with one single wire winding and one bifilar (i.e., twisted pair of wires) wire winding (yielding two windings), you have three wires coming out of each hole on the same end of the core, corresponding to the leads of the three windings.
  - You should carefully strip the insulation from the leads (up to within an eighth of an inck of the core) and tin the leads. Sandpaper can be used to strip the insulation, or you can use an Exacto kinfe toscrape it off. Note that the insulation on the wire Tony provides is Not the heat-strippable type.
  - In most of Tony's kits the core is mounted "standing up" vertically and the windings' lead pairs are inserted into the holes corresponding to the winding.
  - For example, if you wind a transformer with one primary (P) and two secondary windings (S1 and S2), you end up with three leads (Pa, S1a and S2a) coming out of one hole and three leads (Pb, S1b, and S2b) coming out of the other hole.
  - The board layout in the enhanced builders notes will usually have annotations on the six holes (for a common transformer) that indicate the lead pairs for the primary, and each of the 2 secondaries.
  - The builder then needs to match the holes with the appropriate winding leads. This graphic is an example:



  - T201 (above) has one primary and two secondary windings. When wound, it will have 6 leads in all:
    - two leads (Pa and Pb) and
    - four secondary leads (S1a, S2a, S1b, S2a).



- You should use an ohmmeter to identify each winding pair.

Then slip a 1/8" pice of hookup wire insulation onto the Pa and Pb leads to temporarily provide identification of the primary. Also slip a 1/8" piece of insulation onto the S1a and S1b leads to act as a "spacer for the actual mounting.

- To mount the core, the builder typically starts with the Primary leads, removing the insulation piece and orienting the core such that (in the above instance):
  - the core hole from which Pa lead exits is aligned with the P hole on the top row of the holes and
  - the core hole from which the Pb lead exits is aligned with the P hole on the bottom row.
- Then insert those primary leads into their corresponding holes.
- Then take the first pair of S leads (e.g., S1a and S1b) and similarly align with and insert into the "S1" holes (S1a on the top and S1v on the bottom row of holes in the graphic above).
- Finally do the same thing with the remaining lead pair (S2a and S2b).
- Then pull through all of the leads from the bottom of the board to ensure no leads have any loose ends or loops topside and the transformer is nice and snug on the board and the 1/8" spacer
- Solder all leads and you're ready to test them.

no

da

ap

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Softrock Lite + USB Xtall V9.0 Band Pass Filter Stage

ntroduction

heory of Operation

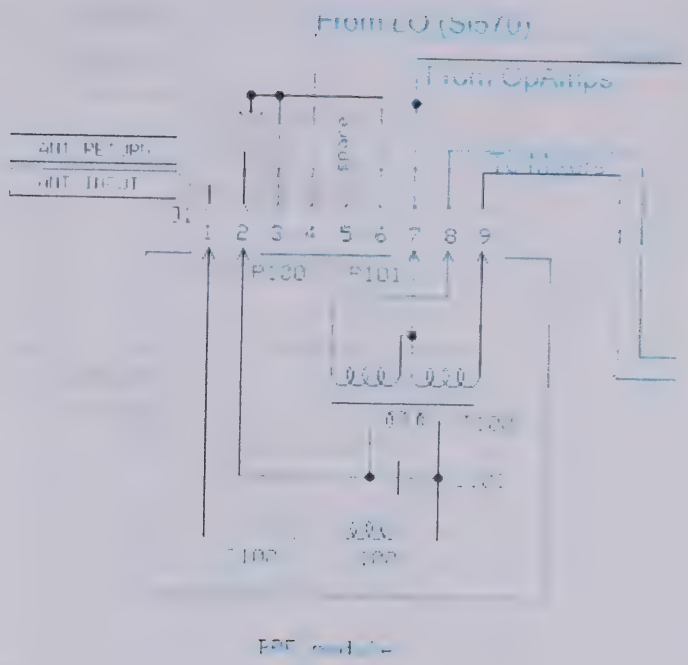
his stage lets the SDR filter out the RF spectrum arriving at the antenna into a "chunk" of the RF pectrum corresponding to the desired band(s). This is filtering "in the large", and is designed to inimize interference/harmonics from very strong, out-of-band signals.

here are four separate, pluggable boards which can be built to provide BPF functionality over the ange from 160m to 10m.

ike KF4BQ has conducted tests on the BPF boards to determine the frequency boundaries of these chunks" (the passbands) of RF spectrum. You can view the results here.

ote: the pluggable bandpass filters may be replaced by the new switchable [illegible] kit, which nplements 4 switchable BPFs on a single board, which can be manually switched or switched via SB control.

Schematic



This is a subset of the overall schematic.

Bill of Materials

Band specific [illegible]

Bands	[illegible]	[illegible]	T100
[illegible]	[illegible]	18.7uH, T30-2 red core 60T #30 AWG	1.4uH primary, T30-2 red core 18T #30 AWG on primary 9T #30 AWG on each bifilar secondary
80m 40m	560pF 680pF	1.5uH, T25-2 red core 22T #30 AWG	1.2uH primary, T25-2 red core 18T #30 AWG on primary 9T #30 AWG on each bifilar secondary
[illegible]	[illegible] 220pF	0.8uH, T25-6 yellow core [illegible] #30 AWG	0.6uH primary, T25-6 yellow core [illegible] #30 AWG on primary 7T #30 AWG on each bifilar secondary
[illegible]	82pF 330pF	[illegible]	0.13uH primary, T25-6 yellow core [illegible] #30 AWG on primary 4T #30 AWG on each bifilar secondary

Designation	Value	Color/Code	Orientation	Category	Notes
BPF-1					160m board
P100-1	2 pin				
P101-1	3 pin				

C100-1	390 pF	391		ceramic	
C101-1	5600 pF	562		ceramic	
T100-1	1.4 uH	T30-2 (red)			18T/9T bifilar #30 (10"/5")
L100-1	18.7 uH	T30-2 (red)			66T #30 (32")
-					
BPF-2					80/40m board
P100-2	2 pin				
P101-2	3 pin				
C100-2	560 pF	561		ceramic	
C101-2	680 pF	681		ceramic	
T100-2	1.2 uH	T25-2 (red)			18T/9T bifilar #30 (10"/5")
L100-2	1.6 uH	T25-2 (red)			22T #30 (11")
-					
BPF-3					30/20/17m board
P100-3	2 pin				
P101-3	3 pin				
C100-3	180 pF	181		ceramic	
C101-3	220 pF	221		ceramic	
T100-3	0.6 uH	T25-6 (yellow)			14T/7T bifilar #30 (8"/5")
L100-3	0.78 uH	T25-6 (yellow)			17T #30 (9")
-					
BPF-4					15/12/10m board
P100-4	2 pin				
P101-4	3 pin				
C100-4	82 pF	82		ceramic	
C101-4	330 pF	331		ceramic	
T100-4	0.13 uH	T25-6 (yellow)			7T/4T bifilar #30 (5"/4")
L100-4	0.53 uH	T25-6 (yellow)			14T #30 (8")

Summary Build Notes

Cut the provided board into 4 BPF boards.

For each desired band pass filter board (BPF-#):

- Install pins to board bottom
- Install ceramic caps to topside
- Wind and install inductors
- [illegible]

Detailed Build Notes

here are four bandpass filters (BPFs) you can build, each on its own board with 2 caps, a coil, a

transformer, and two sockets for plugging it into the main board. The Bill of Materials above provides you with the parts list for each board. You only need to build one BPF to test out your receiver capability. It is recommended - especially if you are inexperienced in winding coils and toroids - to begin with a BPF for the band you are least interested in (just to get the practice in a non-threatening fashion).

Saw The Boards

The BPF filter boards are in a strip of four boards and will require the kit builder to hacksaw between the boards to separate the individual BPF boads. It is suggested to use a small plastic miter box and a fine-toothed blade (24 tpi or better) to help cut perpendicularly across the 0.65 inch wide strip. This seems to work well. However, please note the [illegible] concerning the danger in inhaling the dust resulting from sawing.

Winding Inductors

To learn how to wind coils and transformers, please read the [illegible] to instruct you in the techniques required for this task.

Concernimg the number of turns in the windings, David WW2R has reported that he had to adjust the number of windings on L100-1 (the 66 turn coil on the 160m band) because of the fact that the toroid was not able to accept 66 turns as a single layer, without winding back over some of the existing winding. Overlapping turns caused him to need 69 turns to reach the required inductance of 18.7 uH.

Pete N4ZR chimed in on this subject, too, adding: "The 160-meter L100 requires 66 turns, but only about 40-45 turns will fit on the core in a single layer. You need to keep winding in the same direction

in a second layer until you complete the 66-69 turns. I wound 69 originally, but on checking with my MFJ-259, which may not be very accurate the inductance appeared to be a little high.

When winding bifilar windings, it is a lot easier to wind the bifilar winding if you fold the wire in half but don't cut, and use the folded (closed) end (with or without a sewing needle) to feed through the toroid or binocular core.

Wire Lengths

:

Refer to the BOM above to see the recommended length of wire (in inches) for each inductor. These lengths include generous SWAGS to accomodate lead lengths, etc.. These were determined using (adding an inch or so to the resultant length, just for good measure.

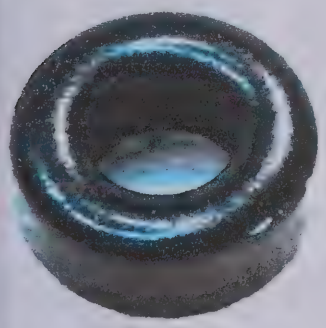
When the BOM states BPF-80/40: 18T/9T bifilar #30 (10"/5"): this means:

- Primary: 18 turns of #30, using 10" for the single winding.
- Secondaries: 9 turns of #30, using a 10" length of wire and fold it over at the 5" point, twisting it together into a bifilar strand, winding it evenly distributed over the primary winding for 9 turns. The bifilar strand should be about two-three twists per inch.

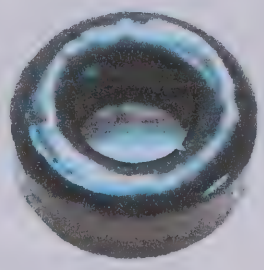
Core Sizes

: The chart below provides the capacitance values and the winding instructions by band group. Carefully note that some bands use different size and color cores. Be sure to use the right core for the board you are building:

1. 160 m: T30-2 (red)
2. 80/40m: T25-2 (red)
3. 30/20/17/15/12/10m : T25-6 (yellow)



T30-2



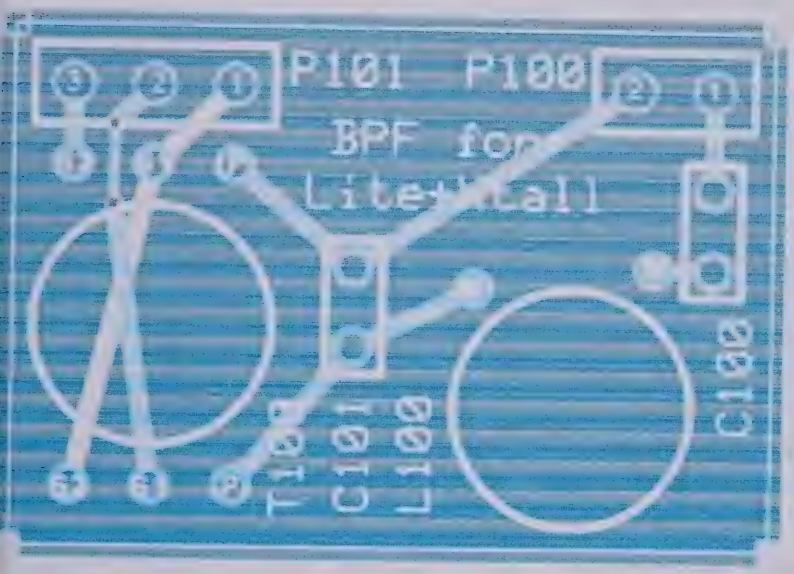
T25-2

T25-6

Band Specific Values

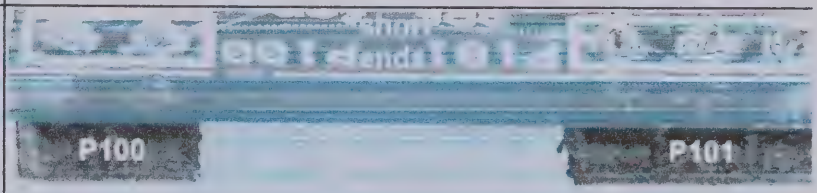
Bands	C100	C101	L100	L101
160m	390pF	560pF	18.5uH, T30-2 red core 66T #30 AWG	1.4uH primary, T30-2 18T #30 AWG on primary 9T #30 AWG on each bi
80m 40m	560pF	680pF	1.6uH, T25-2 red core 55T #30 AWG	1.2uH primary, T25-2 18T #30 AWG on primary 9T #30 AWG on each bi
30m 20m 17m	180pF	220pF	0.8uH, T25-6 yellow core 37T #30 AWG	0.6uH primary, T25-6 14T #30 AWG on primary 7T #30 AWG on each bi
15m 12m 10m	82pF	330pF	0.33uH, T25-6 yellow core 24T #30 AWG	0.13uH primary, T25-6 7T #30 AWG on primary 4T #30 AWG on each b

For Each BPF Board



(referring to the Band Specific Values chart, above):

Check	Designation	Type	Notes
	L100-#	Coil	Wind, prepare, horizontally mount, and solder the coil, L100, us the correct core size and color and turn count.. • Carefully count the turns[1]. Each pass thru the center is 1 tu • Leave approximately 1/2 inch for each lead. • Use an emery cloth to scrape the insulation off the leads u the last 1/8 inch. • Pull the leads through the holes directly above the circle fo L100 on the BPF board (marked in yellow above). • Flatten the core horizontally, pull the leads snug, bend ther the bottom side of the board, and solder the leads. • Test for continuity (~0 ohms) from the lower hole of C100 through the coil to the lower hole of C101. • If there is no continuity, check soldering of the leads and resolder as necessary.
	T100-#	Transformer	Wind, prepare, horizontally mount, and solder the transformer, • Transformer T100-# will be mounted horizontally and raise above the board about 1/16 of an inch. In winding T100-#, wind the primary winding with enameled wire so that the primary winding starts and ends at about the same point o core and is uniformly spread around the core. • Twist two pieces of enameled wire together (bifilar) at abou twists per inch and wind the secondary windings with the windings starting and ending where the primary winding st and ends. When you have wound the transformer, you will 6 leads, 3 (one primary, one secondary 1, and one second 2) on each side of the core. • When trimming the wires, recognize that the 3 leads comir from one side of the core may need to be a little longer tha those from the other side (to facilitate mounting the transfo horizontally. • Insert the leads, following the annotations on the BPF boa above: o "P" represents the primary leads on each side of the c o "S1" represents the leads for the first secondary windi each side; o "S2" represents the leads for the second secondary winding on each side. • Test for continuity on the two primary leads ("P" in the imag above) by putting your ohmmeter leads on the two holes fc C101. If you do not have continuity, then you likely have a

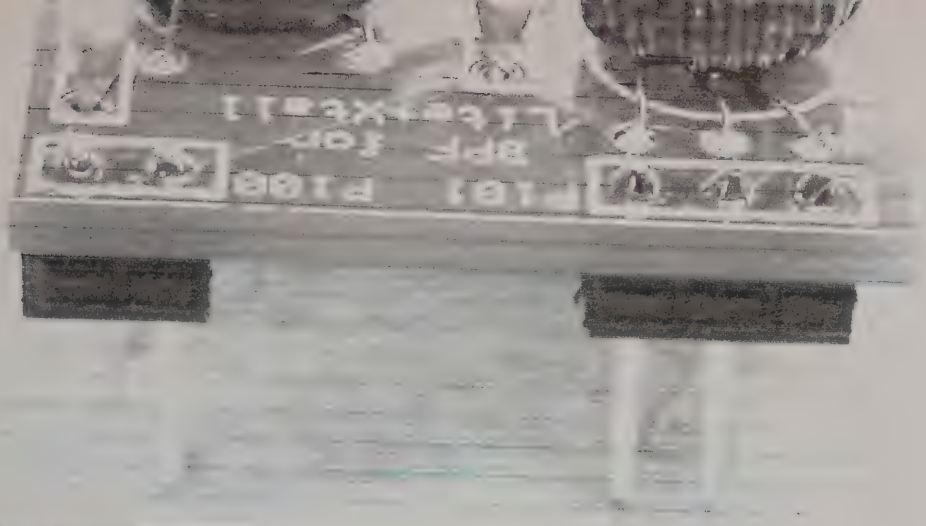
			soldering issue on the primary leads. • Test for continuity between either of the primary leads and of the secondary leads. You should see an open circuit. • If you **do** get continuity, look for a short in the transformer (its solder joints. • Test for continuity between pins 2 and 3 of P101. You shou get continuity. • If you do not get continuity, one or more of your secondary leads has a solder problem.
	C100-#	ceramic capacitor	Mount and solder the capacitor, C100
	C101-#	ceramic capacitor	Mount and solder the capacitor, C101
			
	P100-#	2 pin header	Mount and solder the 2-pin header, P100, on the underside of t board, with the shorter pins going through the holes from the bottomside to the topside and the longer pins extending out fro bottom side to mate with the main board [2].
	P101-#	3-pin header	Mount and solder the 3-pin header, P101, on the underside of t board, with the shorter pins going through the holes from the bottomside to the topside and the longer pins extending out fro bottom side to mate with the main board. [2]

The L-100 for the 160m BPF will require overlapping the windings in order to fit all of them on the toroid. The first layer retty well fills up after 45 or so turns.

The BPF board connectors (P100 and P101 headers) are mounted, short ends into the holes for P100-# and P101-#, on the ottom of the board with the other components on top.

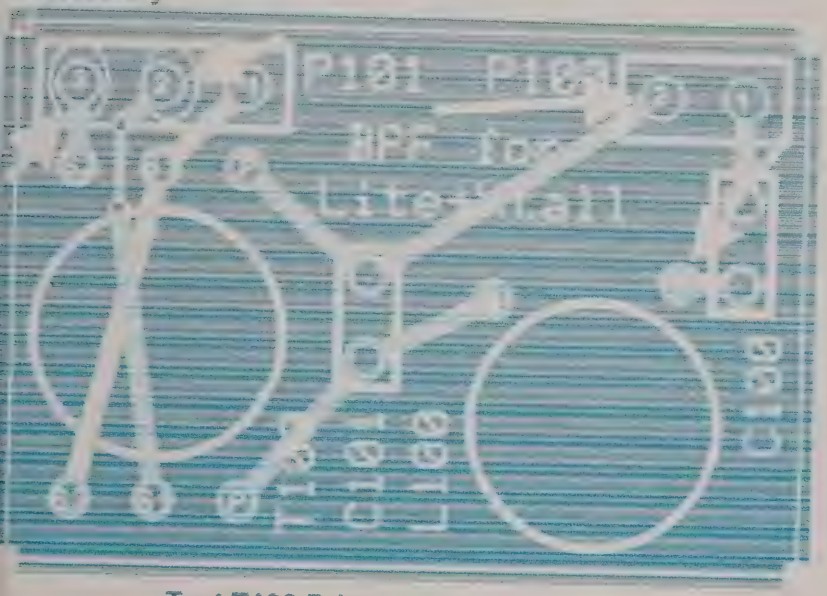
Ise the main board 9-pin socket (J1) as a "tool" to align the pin headers on each BPF board so that the two will mate roperly.

Completed Board (80/40m)



Testing

Continuity



Test T100 Primary Resistance

- With the BPF board NOT mounted to the main board and using your ohmmeter, measure the resistance from The C100 hole farthest away from P100 to ANT Return. It should be ~0 ohms, indicating continuity in the primary windings of T100, through the L100 windings.
- If you get any appreciable resistance or an open circuit, you should inspect/touch up the solder joints on T100 primary and/or L100.

Test T100 Secondaries Resistance

With the BPF board NOT mounted to the main board and using your ohmmeter, measure the resistance between pins 2 and 3 of P101 on the BPF board (which correspond, respectively, to pins 8 and 9 of J1 on the main board) - see the two testpoints circled in the image above..
It should be ~0 ohms, indicating continuity between the ends of the two secondary windings and through the center tap.

If you get any resistance or an open circuit, you should inspect and/or touch up the solder joints.

pwr supply incl 5V + 3.3V regs

3.2 mA

add L.O. 75 mA

add X divider

87 mA

add op amp

96 mA

add mixer

96 mA

add connectors

still 96 mA

Softrock Lite + USB Xtall V9.0 Power Supply Stage

;

Introduction

Theory of Operation

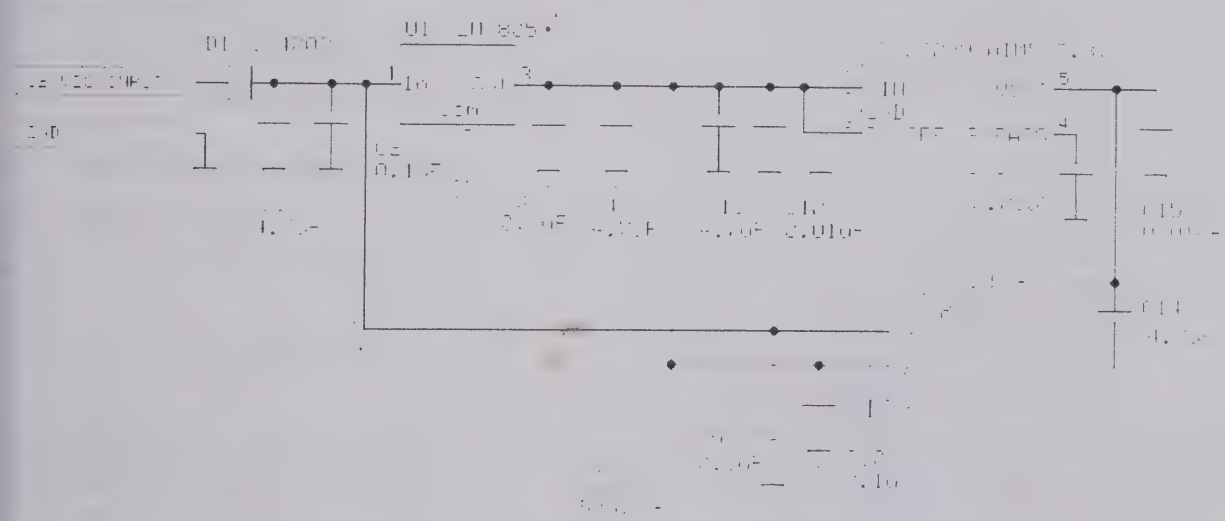
This stage provides the two power rails for the radio:

- a regulated +3.3 Vdc for the local oscillator stage
- a regulated +5 Vdc for the divider, mixer, and opamp stages

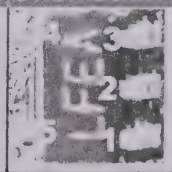
Note that the USB stage is powered from the PC's USB port's +5Vdc

Schematic

This is a subset of the



Bill of Materials

Designation	Value	Color/Code	Orientation	Category	Notes
U3	LP2992AIM5-3.3V	LFEA		SMT	marked "LFEA"
C12	0.01uF			SMT 1206	

C13	0.01uF			SMT 1206	
C15	0.01uF			SMT 1206	
C02	0.1uF			SMT 1206	black marked strip
C03	0.1uF			SMT 1206	black marked strip
C09	0.1uF			SMT 1206	black marked strip
C10	0.1uF			SMT 1206	black marked strip
C01	4.7uF	475		ceramic	
C04	4.7uF	475		ceramic	
C11	4.7uF	475		ceramic	
C14	4.7uF	475		ceramic	
D1	1N4003		W-E		
U1	LM7805		TO-220		
J2	3 pin				

Summary Build Notes

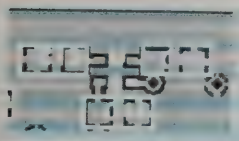
- Install SMT ICs and Capacitors (bottom)
- Install ceramic capacitors (top)
- Install D1 (top)
- Install U1 (top)
- Install power bus jack, J2
-

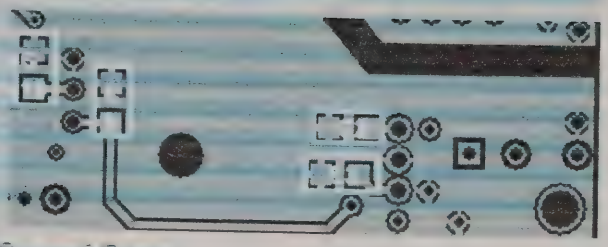
Detailed Build Notes

Bottom of the Board

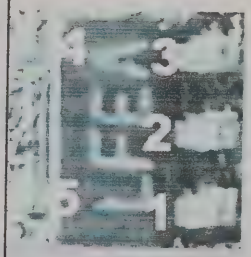
The challenge here is the extremely tiny 3.3V regulator, U3. Be very careful tweezing this component, as, if it ever gets launched into space, it will be nigh on impossible to find.

Also be careful to note the two different types of SMT caps. There are three 0.01 uF caps and four 0.1 uF caps, the latter being identified by a black stripe drawn on the plastic carrier strip.





Install SMT ICs and Caps

Designation	Value	Color/Code	Orientation	Category	Notes
U3		LFEA		SMT SOT-23	INVERTED SIDE FACING UP INVERTED SIDE DOWN

C12	0.01uF			SMT 1206	
C13	0.01uF			SMT 1206	
C15	0.01uF			SMT 1206	
C02	0.1uF			SMT 1206	black marked
C03	0.1uF			SMT 1206	black marked
C09	0.1uF			SMT 1206	black marked
C10	0.1uF			SMT 1206	black marked

Top of the Board

Install Ceramic Caps

Designation	Value	Color/Code	Orientation	Category	Notes
C01	4.7uF	475		ceramic	
C04	4.7uF	475		ceramic	
C11	4.7uF	475		ceramic	
C14	4.7uF	475		ceramic	

Install Diode and U1

Designation	Value	Color/Code	Orientation	Category	Notes
D1	1N4003	Anode Cathode	W-E		Hairpin style hairpin on the lead

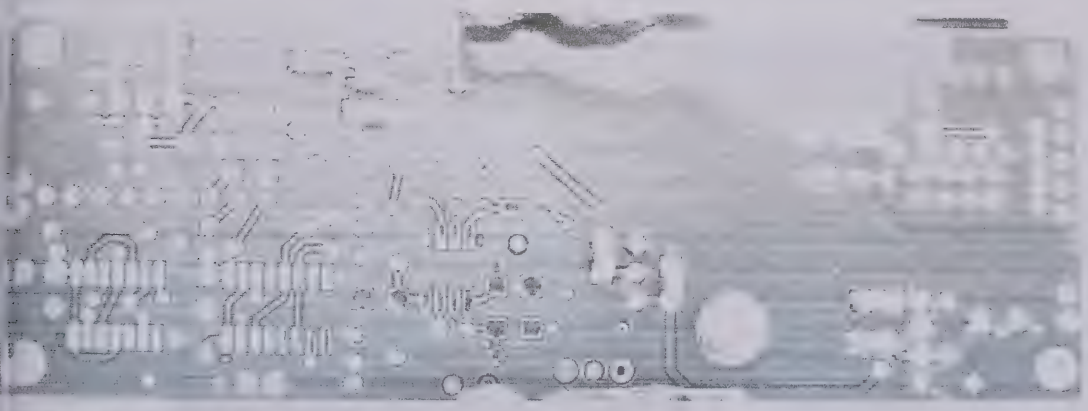
U1	LM7805	TO-220 GND			M V r L L t b a n s l a n a t L b

Install Power Bus Jack J2

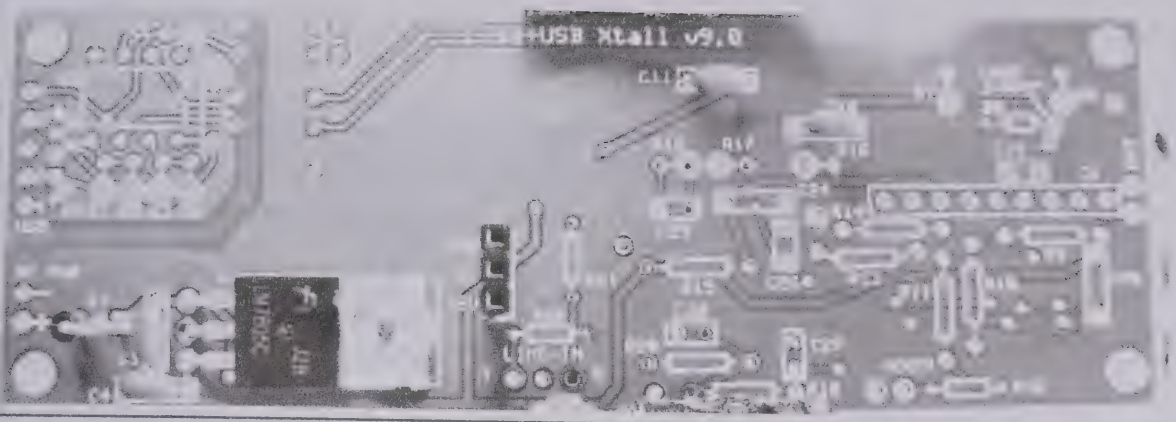
Designation	Value	Color/Code	Orientation	Category	Notes
J2	3 pin				

Completed Stage Photos

BottomSide



Topside



Testing

Current Draw

Test Setup

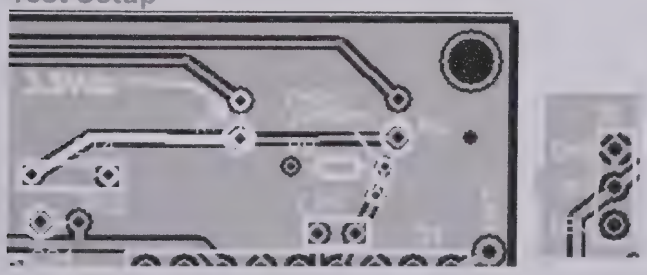
- To power up the 0 receiver you will need a 9 volt to 12 volt DC source or a battery over-the-wire. A supply that is free of ripple and noise is best.
- Before you power the board up for the first time, connect a mA meter in series with the power lead and to be safe, place a 1k ohm resistor in series with the power lead. This can be in either the + or - line. This will limit the current from to <=12 mA if you have a short on the board.
- After you see that the current draw is acceptable, remove it and reconnect the current meter.
- The current draw with this initial stage, and no other loads, should be 3-5 mA.

Test Measurements

Testpoint	Nominal Value	Author's	Yours
Current draw thru 1 k limiting resistor	**3-5 mA**	**3.1 mA**	
Current draw without limiting resistor	**3-5 mA**	**3.2 mA**	

Voltages

Test Setup



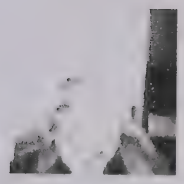
- Power up the board with 12 Vdc.
- Using a DMM, measure the voltage on the +12 power connector (J2 pin 1).
- The 12 volt rail should be approximately 12 Vdc. It should have a

voltage drop from the power source on the order of 3.15 - 3 Vdc, representing the resistance of C1's ohmic resistance in the circuit.

Test Measurements

Testpoint	Nominal Value	Author's	Yours
3.3 V Rail: R7 body hole (see above)	3.3 Vdc	3.29	
5 V Rail: J2-Pin2	5 Vdc	4.97 Vdc	
12 V Rail: J2-Pin3	12 Vdc	11.4 Vdc	

jbbeyer <beyer@engr.wisc.edu>
elect. BPF
May 31, 2009 3:33:35 PM CDT



Posted by: "n8ewy"
Sun May 31, 2009 4:01 am (PDT)

A little. It's time to hook this thing all together. I've completed the v9.0 and switching BPF. I powered it up and watched 40 meters come in great with lots of activity .... it was unbelievable! I see that there needs to be an interface cable between the two.

1. Is there a site that shows a pic of these two connected?

2. The only part I have left in the two kits that looks like it might be used in this interfacing is 1 two pin female header. Do we need to make our own interface cable?

3. Does the cable run between J3 v9 and JP1 or JP2 on the BPF?

4. Does the jumper cover go over the unused jumper (JP1 or JP2) when the cable is connected to the other jumper? Is the jumper cover optional on the unused jumper next to the cable.

5. Does it matter what kind of wire is used to make this jumper cable?

6. Seems like there should have been two connectors provided to make this jumper. Am I missing something or is there a different procedure or method used to make this connection?

I know this is a little much for such a small question but I don't see where this is covered anywhere in the documentation. Not clearly. I probably didn't look close enough.

Thanks and 73
Dohn N8EWY GO REDWINGS!

Posted by: "Tony Parks"
Sun May 31, 2009 4:20 am (PDT)

Hi Dohn,

The 2-pin socket provided in the Electronically Switched BPF kit is for use at the end of a kit builder supplied cable to plug onto header J3 on the v9.0 board. The other end of the cable needs to be soldered to the BPF board at JP1-1 and JP2-1. (The jumper plugs that can be used to test the BPF board are NOT used when the BPF selection is from the v9.0 board.) The cable length only needs to be an inch or so and any small gage insulated wire would be suitable.

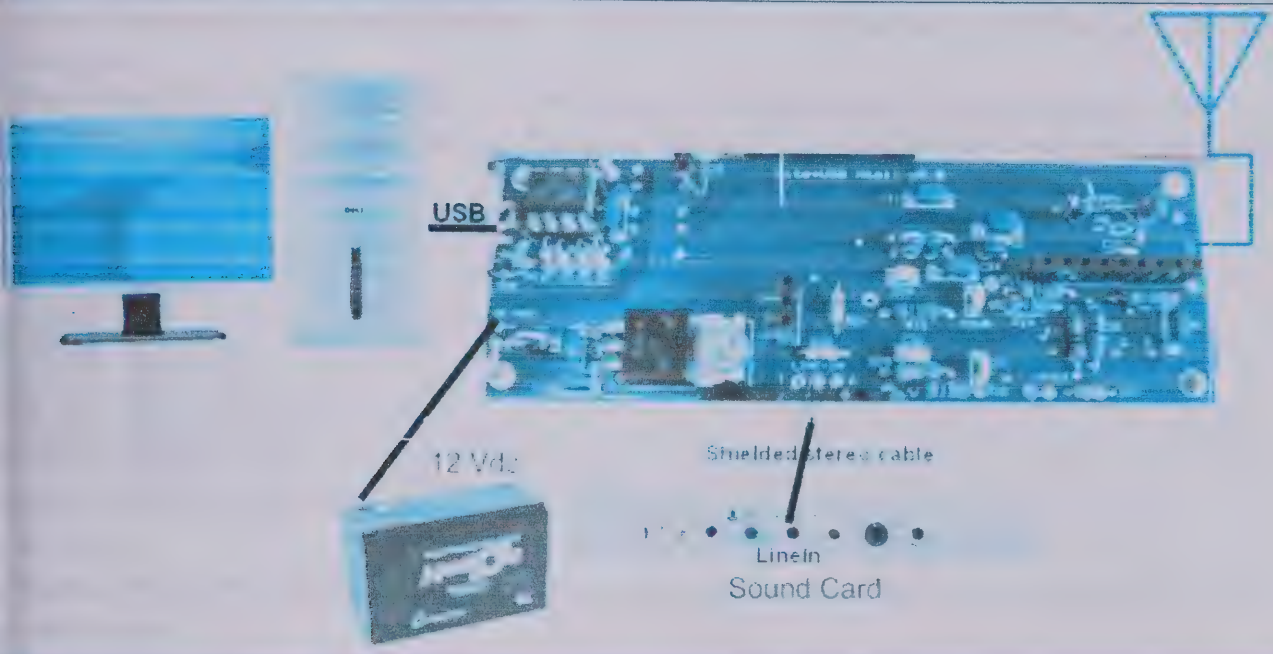
I will send you a schematic directly to your e-mail address.

Glad to hear the v9.0 receiver is playing for you.

73,
Tony Parks

Softrock Lite + USB Xtall V9.0 - External Connections

Introduction



Summary Build Notes

- Set up Rocky's ".INI" file for Multiband Operation
- Connect the I and Q output lines
- Connect the Antenna
- Connect the power leads/connector
- Testing

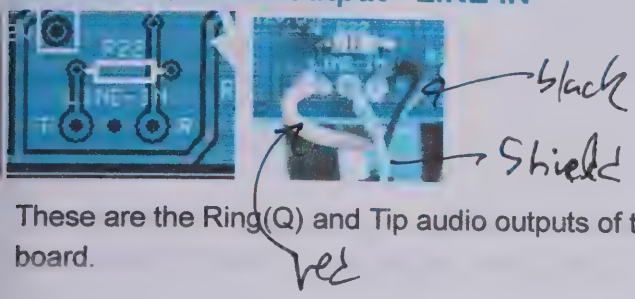
Detailed Build Notes

Setting up Rocky.ini File for Multiband Operation

If you are using Rocky, you should set up the ".INI" file in Rocky (rocky.ini) to allow for multi-band operation. This process is simple and involves adding lines in the "[Bands]" section of rocky.ini to designate the text to display for and the center frequency ofeach band selection.

For details, see the example in this link.

RX I and Q Audio output - LINE IN



These are the Ring(Q) and Tip audio outputs of the board, located at the bottom center edge of the board.

Depending upon your ultimate enclosure/mounting requirements, you want to connect these three pads to good quality shielded 2 conductor audio cable, terminated either by a 3.5 mm mini plug or a mini jack.
Use a short length of solid hookup wire, soldered to the shielding and to the ground/common connection, and wrapped firmly around the outer insulation of the cable as a strain relief mechanism.

Antenna Connection

Sample Antenna Connection

ANT/RET

These are the ANT and (unmarked) Return connections located on the right-hand side of the board, near the top.

Use RG-174U 50 ohm "micro" coax for the antenna connection, There is a good [illegible] available on the internet.

Use the strain-relief technique illustrated above.

Finally, regarding the "floating antenna RET" connection, review the messages in [illegible] where the builder was getting no signal and the cause was the improper ANT RET connection.

Power Connection

Completed Stage

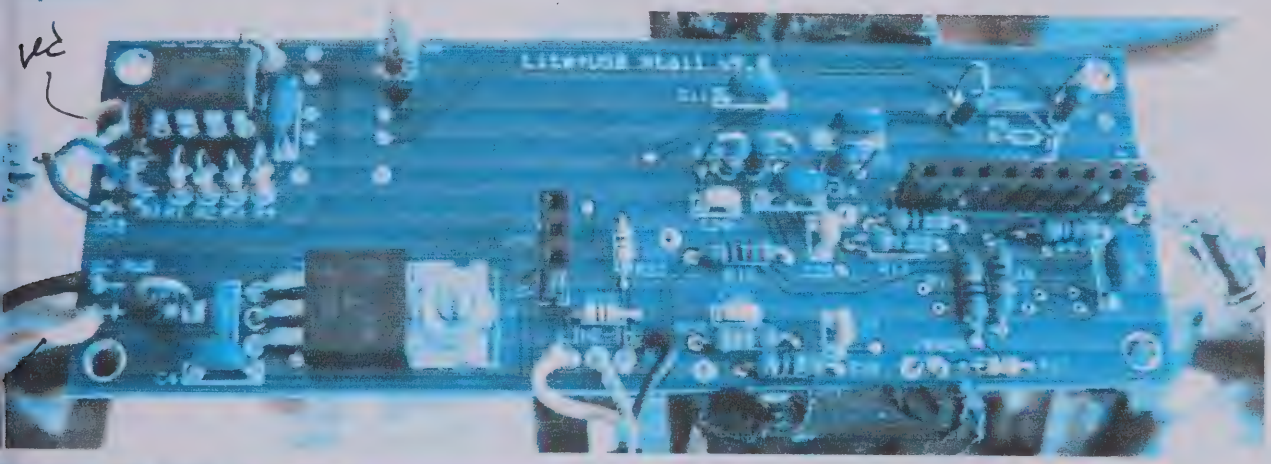
Sample Power Connection

PWR

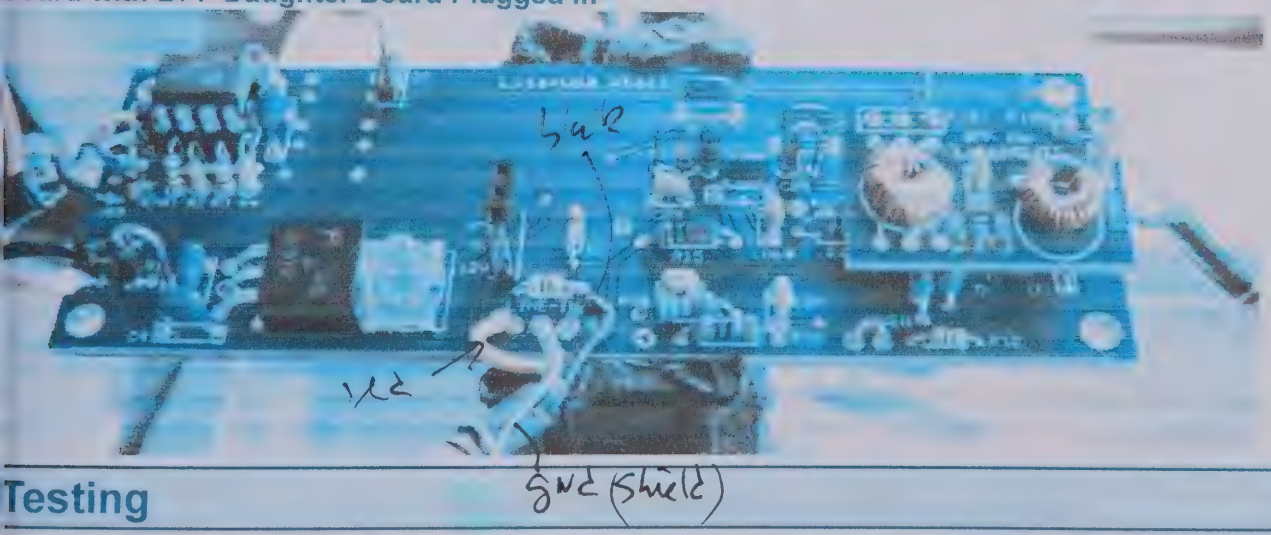
To power the v9.0 receiver you will need a 9 volt to 12 volt DC source at a little over 100 mA. A supply that is free of ground connnections works best.

Use the conventional red/black wire for the power line +/- connections with the connector of your choice.

Topside



Board with BPF Daughter Board Plugged In



Testing

Note: This stage test requires you to have built and plugged in at least one [illegible].

The test assumes you have built an 80/40m BPF.

Current Draw (DMM)

Since you have just installed the various connections, it is a good idea to check the current draw one more time.

- Current numbers here are for the CMOS version of the Si570. You will need to adjust these up by about 14 mA for the LVDS version.
- Power the board up (author has been using an 11.6 Vdc battery pack)
- Measure the current draw and 5 V rail voltage with a 1K Ω limiting resistor
- Measure the current draw without the limiting resistor.
- Remove power

Testpoint	Nominal Value	Author's	Yours
Current Limited mA	6-10 mA	7.5 mA	_____
Current limited 5V rail	1-2 Vdc	971 mV	_____
Non limited draw mA	90-100 mA	97.0 mA	_____

RX Test in Rocky

The ultimate test is to run Rocky, feeding the Ring and Tip outputs to the Line In inputs of your PC's sound card. You must have built at least one of the Bandpass Filter Boards (BPF) to conduct this test. The values below are appropriate for the 80/40m BPF Board.

With the 80/40 BPF board in place and a stereo cable installed (see above) for the ring, tip, and common audio output connections:

- Follow this sequence to connect the board and the PC (important note: there have been cases where this sequence was not followed and damage to the board resulted)
  - Plug the audio cable into your sound card's Line-In input
  - Power up the board
  - Plug the USB cable into the PC
- Run Rocky, click the `File > Start Radio` menu choice, and click on the

View > Settings menu

- Click on the "Audio" Tab and select your sound card
- Set Rocky's center frequency at 7.046 MHz (if it is not already selected) in the "I/Q Input Device" dropdown box).
- Click on OK to close the "Settings" Menu
- Set up your transceiver (or other signal source) to transmit a low power signal at 7.059 KHz into a dummy load and loosely couple it to the board with a short wire
- Click on Rocky's File/Start Radio
- You should see the Rocky spectrum display resembling the image above.
- If your signal source can sweep the frequency, observe Rocky's spectrum display as the generator sweeps through the "chunk" of bandwidth centered on the center frequency.
- If you see an unwanted "mirror image" of the desired signal, you may want to check out the image rejection hints on this website.

HF BPF Project

Search: Search selected SDR sites

Project Introduction

General

This kit is a daughter board, designed by Jan G0BBL and Tony KB9YIG, that provides four electronically switched band-pass filters for the Softrock Lite + Xtall V9.0 RX, replacing the single-band daughter board in the original design.

Prices and availability of the kit and its options are found at the

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The electronically switched BPF board is 2.5 inches by 0.95 inches. The height will be less than 0.5 inches not counting the extension of the connector pins perpendicular to the bottom of the board.

Options

The kit can be built in two different "flavors", each providing four switchable bands:

- Option 1: A 160 - 10m version (see main schematic, below), and
- Option 2: A 80-10m + 6m version (see inset in lower left corner of schematic below)

The kit will ship with parts that enable the builder to decide what bands (which "flavor") he/she desires. The board itself works for both option 1 and option 2. The differences are in the components for the first 2 bands (Caps C07 - C12 and coils L1 - L6.

Applicability

The board can also be used with the earlier RXTX V6.3 and RX V8.3 kits. However, in those cases, the builder must supply the required +5 Vdc bus (and ground connection) to the HF-BPF board, there being no matching sockets therefor on the earlier boards.

Bandswitching

If you use Rocky as your SDR, the project initially is manually switched, using two header pins and their associated jumpers.

Starting with v9.0 kits shipped after 21 Feb 2009, the USB interface microprocessor will be an ATTiny85 device with JanG0BBL's new enhanced features code. If there is interest in a programmed ATTiny85 device for an existing v9.0 receiver, contact Tony Parks and he will price the replacement device to cover device cost, PayPal loss and mailing cost.

PowerSDR and Winrad have enabled the programmatic switching of the board.

Interfacing to V9.0 RX

Included in the kit is a two pin socket section to interface with J3 on the RX v9.0 board. Wires need to be connected to the two jumper plug locations, (with the jumper plugs not used), on the switched BPF board to the two pin socket section. This then is the plug connection between the v9.0 board and the electronically switched BPF board. An insulated sleeve may be put on the little plug to give it a more finished look and a mark may be added to indicate polarization.

Filter VNA Tests

Mike Collins KF4BQ tested (on 13 December 2008) the completed board and the results can be found

The latest schematics (1/12/2009) are at the following links:

-
-

- The board gets its power and control signals, as well as inputs and outputs, from the appropriate points on the Softrock Lite + Xtall RX V9.0
- Control signals (two inputs that can each be "high" or "low", resulting in four possible combinations) are available at J3 on the V9.0 board and are provided to this board via a cable connection to the holes for P102.
- Power (regulated +5 Vdc) comes from the 3-pin J2 on the V9.0 board via P101
- The RF antenna inputs and the balanced RF outputs are facilitated via P100, which plugs into the V9.0 board's 9-pin J1.
- RF in and out are coupled via transformers. T1 couples RF from the antenna into U1, the first of two switching ICs. The second switch, using the same truth table, switches the appropriate bandpass filter circuit through to the output transformer, T2, and thence to the pins of P100 that feed the balanced signal to the V9.0 RX.
- Each switch has four outputs, one for each of the four bandpass filters implemented on the board. The switch routes the RF to the appropriate filter, based upon the levels present at S0 and S1 (which can be set via JP1 and JP2), according to the following truth table:

JP1 (S0)	JP2 (S1)	Band
jumpered	jumpered	1.8=4 MHz
open	jumpered	4-8 MHz
jumpered	open	8-16 MHz
open	open	16-30 MHz

A Few Words About The Coils from Jan G0BBL

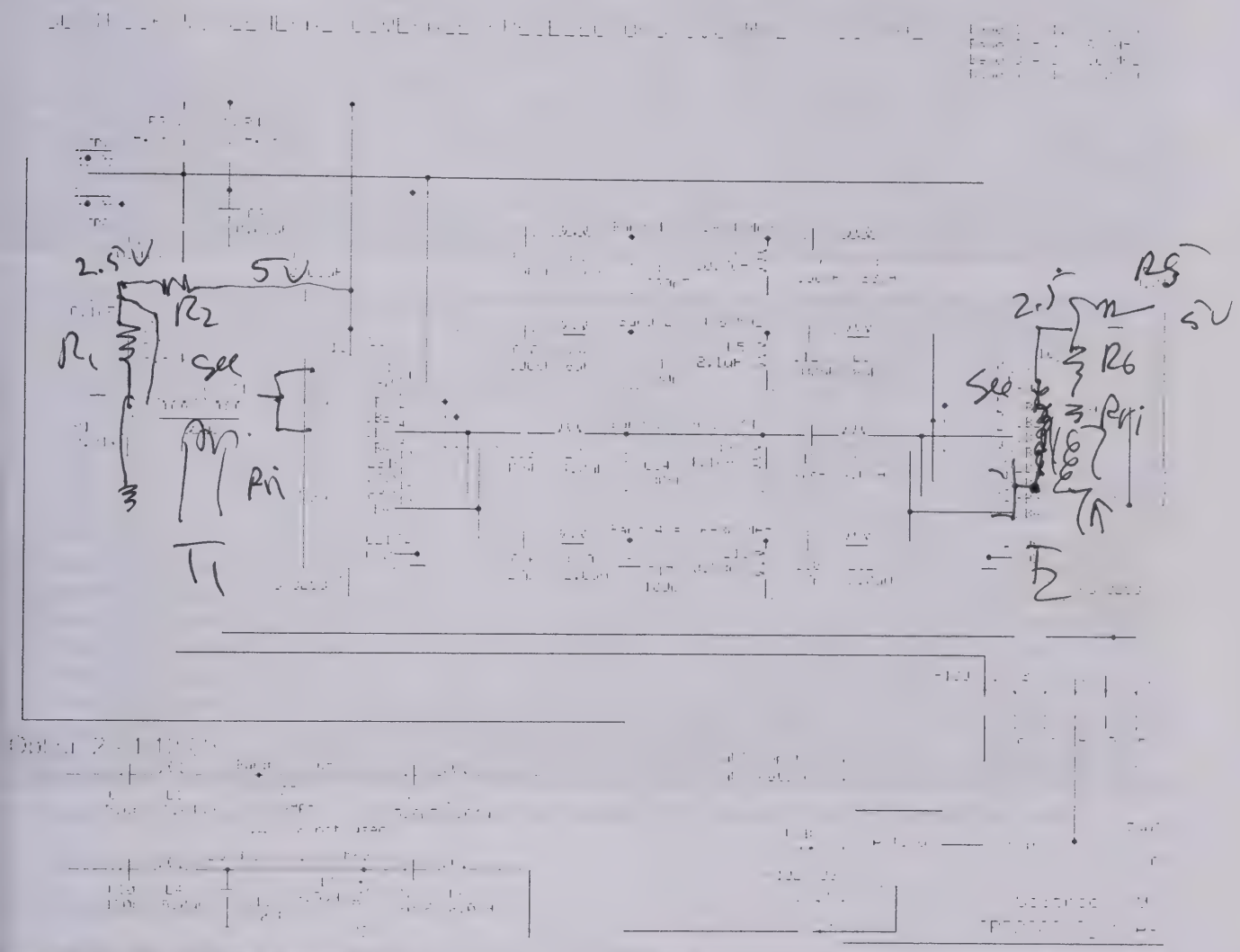
Turn Counts and Inductances

- Coil winding data is based on the manufacturer's data used in the toroid calculators that are avaiable. If you do NOT have an Inductance meter, then please use these values.
- In practice the value of the toroids will be slightly HIGHER than the design value. This has been confirmed by a number of amateurs. However as it is much EASIER to take off a turn then to ADD turns, I have suggested to Tony and Robby to use the TOROID calculator data instead of the original values which I provided (obtained by measuring coils used in prototype)
- Bodo DJ9CS and Mike W1USN checked their winding data and also suggested to use the data from the Toroid calculator. Please note that the value of the core AL may vary by +/- 10% as has been mentioned elsewhere.
- Critical Coils
  - From experience the inductance of the Centre (center, for the colonials) Coil (ie L2. L5,. L8 and L11) is critical for setting the Centre Frequency of the BPF concerned. If you are sure that a BPF is too low in frequency then you may take the effort to take a turn off the centre inductor.
  - If you have a band which is completely out then closely check the ceramic capacitors. A

hairline crack may indicate the capacitor is faulty. For this reason I would suggest to mount C's about 3mm (1/8") away from the PCB. Capacitors generally will NOT survive desoldering so do not reuse caps.

Project Schematic

(Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)



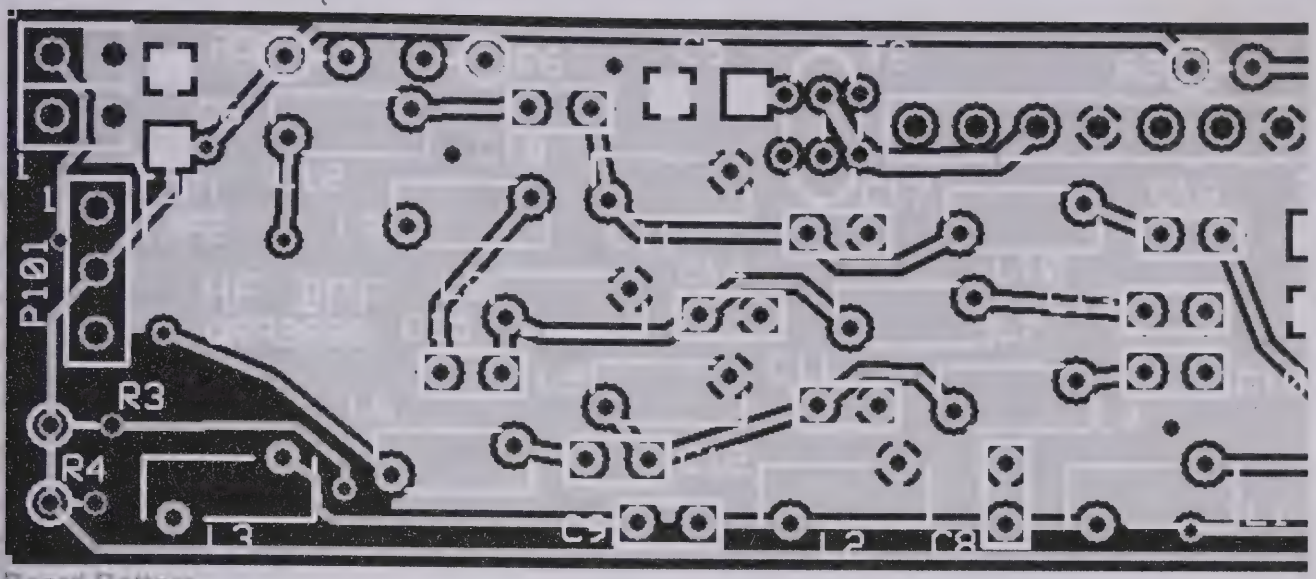
Project Bill of Materials

See

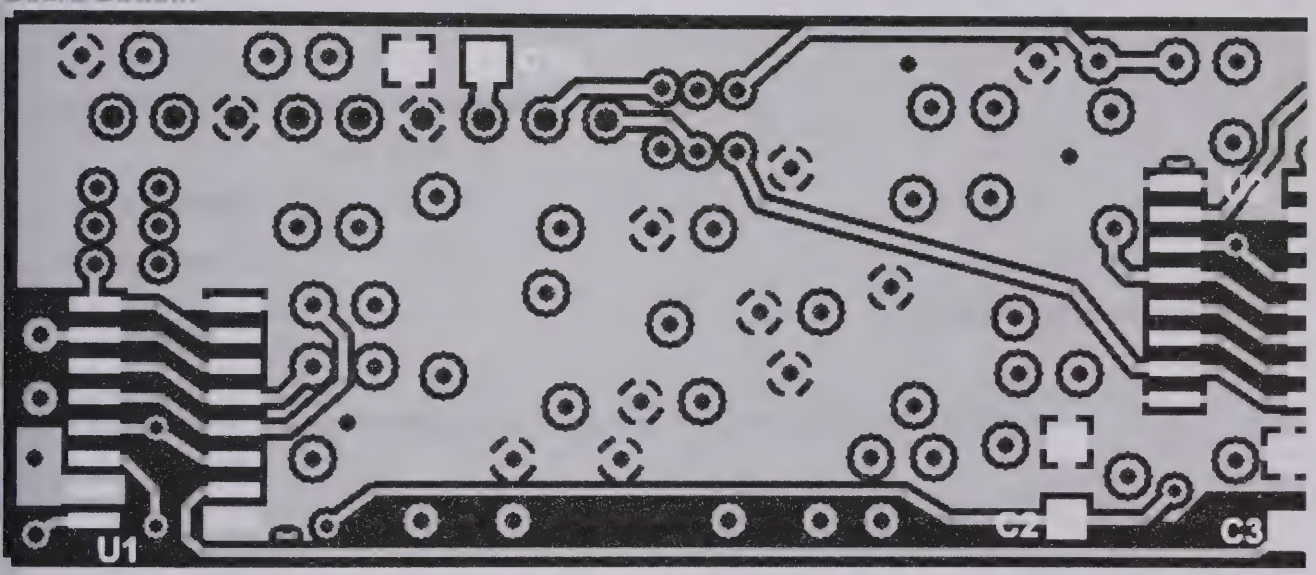
Project Expert's (terse) Build Notes

Board Top

board top



Board Bottom



- Install all SMT and SOIC components to the bottom of the board, then the top of the board
- Wind and install the transformers
- Wind and install the Coils
- Install the ceramic capacitors
- Install the resistors
- Install the jumpers and connectors

Project Detailed Build Notes

For the non-expert builders among us, this site takes you through a stage-by-stage build of the kit. Each stage is self-contained and outlines the steps to build and test the stage. This ensures that you will have a much better chance of success once you reach the last step, since you will have successfully built and tested each preceding stage before moving on to the next stage.

Each stage is listed below, in build order, and you can link to it by clicking on its name below (or in the header and/or footer of each web page).

- Inventory the
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage

Background Info

Tools

Winding Inductors

To learn how to wind coils and transformers, please read the

- and then
- view the excellent videos on
- or take a read of
- You can review the for details on toroidal and binocular inductors.

Soldering

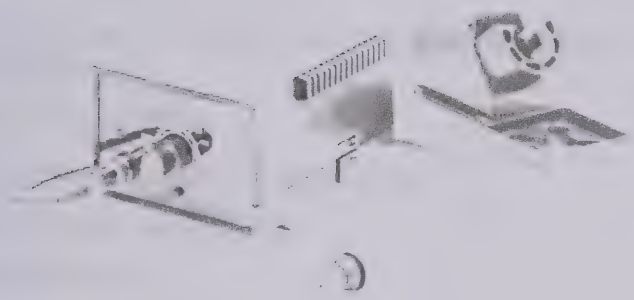
The video below describes techniques for soldering SOIC 14 (and 16 and 8) SMDs

- Read the at the Sparkfun site. It is a very good read and it speaks

great truths. Then take the time to watch the

. Don't skimp here. Soldering deficiencies account for 80 percent of the problems surfaced in troubleshooting. It is preferable to have an ESD-safe station, with a grounded tip. A couple of good stations that are relatively inexpensive are:

- Velleman (approx $20 at Frys)



- Harbor Freight

ESD Protection

- Avoid carpets in cool, dry areas.
- Leave PC cards and memory modules in their anti-static packaging until ready to be installed.
- Dissipate static electricity before handling any system components (PC cards, memory modules) by touching a grounded metal object, such as the system unit unpainted metal chassis.
- If possible, use antistatic devices, such as (see for $25 or the for $15)).
- Always hold a PC card or memory module by its edges. Avoid touching the contacts and components on the memory module.
- Before removing chips from insulator, put on the wrist strap connected to the ESD mat. All work with CMOS chips should be done with the wrist strap on.
- As an added precaution before first touching a chip, you should touch a finger to a grounded metal surface.
- If using a DMM, its outside should be in contact with the ground of the ESD mat, and both leads shorted to this ground before use.

- See the review of ESD Precautions at this .

Work Area

- You will need a well-lit work area and a minimum of 3X magnification (the author uses a cheap magnifying fluorescent light with a 3X lens. This is supplemented by a hand-held 10 X loupe - with light - for close-in inspection of solder joints and SMT installation.
- You should use a cookie sheet or baking pan (with four sides raised approximately a half an inch) for your actual work space. It is highly recommended for building on top of in order to catch stray parts, especially the tiny SMT chips which, once they are launched by an errant tweezer squeeze, are nigh on impossible to find if they are not caught on the cookie sheet.

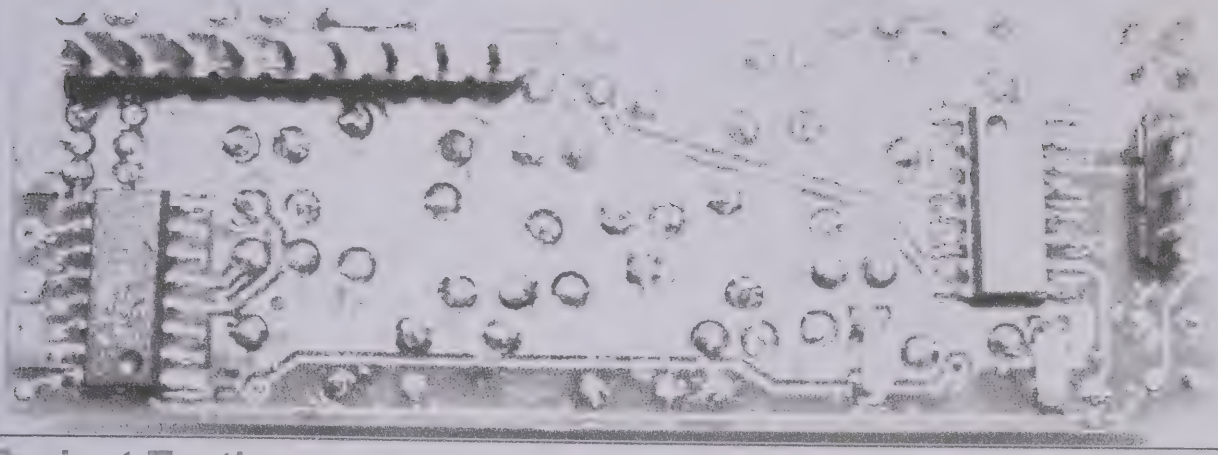
Misc Tools

- It is most important to solidly clamp the PCB in a holder when soldering. A "third-hand" (e.g., or the) can hold your board while soldering. In a pinch, you can get by with a simple . Jan G0BBL suggests "A very cheap way is to screw a Large Document Clip to a woodblock which will clamp the side of a PCB."
-
- Tweezers (bent tip is preferable).
- A toothpick and some beeswax - these can be used to pickup SMT devices and hold them steady while soldering.
- Diagonal side cutters.
- Small, rounded jaw needle-nose pliers.
- Set of jewelers' screwdrivers
- An Exacto knife.
- Fine-grit emery paper.

Project Completed Stage

Top of the Board

Bottom of the Board



Project Testing

Each stage will have a "Testing" Section, outlining one or more tests that, when successfully completed, provide you with the confidence and assurance that you are heading in the right direction towards a fully tested and built transceiver.

When you perform a test, you should always record the results of the test where indicated in the Testing section. This will make troubleshooting via the reflector much easier, since you will be communicating with the experts using a standard testing and measurement regime.

It goes without saying that you should ALWAYS precede any tests with a very careful, minute inspection (using the best light and magnification available to you) to be sure all solder joints are clean and there are no solder bridges or cold joints.

HF BPF Project

electronic switched

Search: Search selected SDR sites

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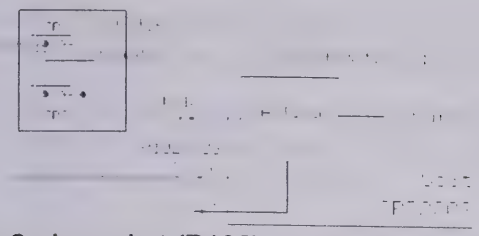

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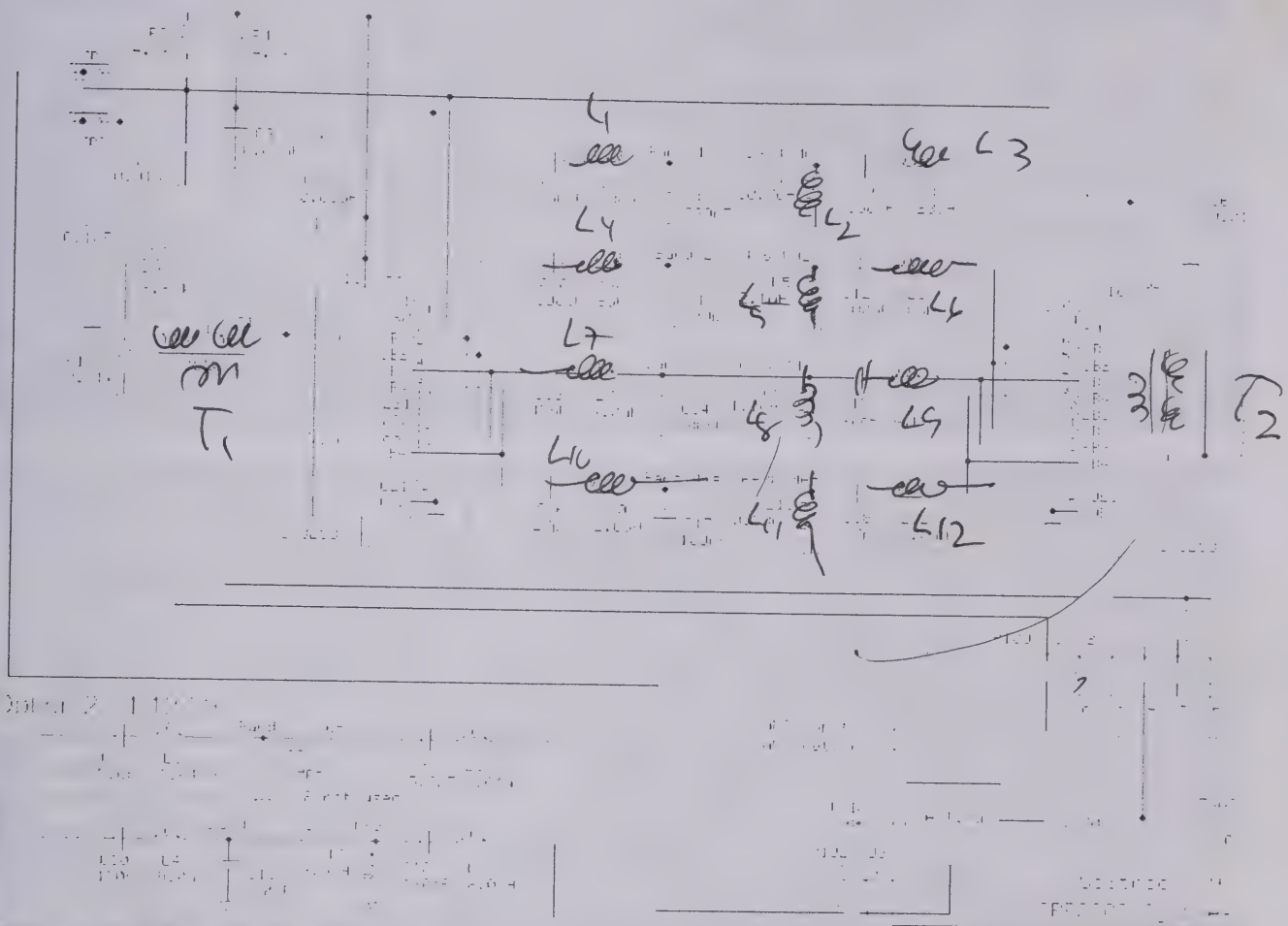
Project Schematic

(Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)



Project Bill of Materials

See

Project Expert's (terse) Build Notes

Board Top

Shunt Series

(25-6 all yellow) (25-6 all yellow)

L1 L2 L3 — L4 L5 L6 — L7 L8 L9 — L10 L11 L12

(25-2 all red)

band 1 — band 2 — band 3 — band 4

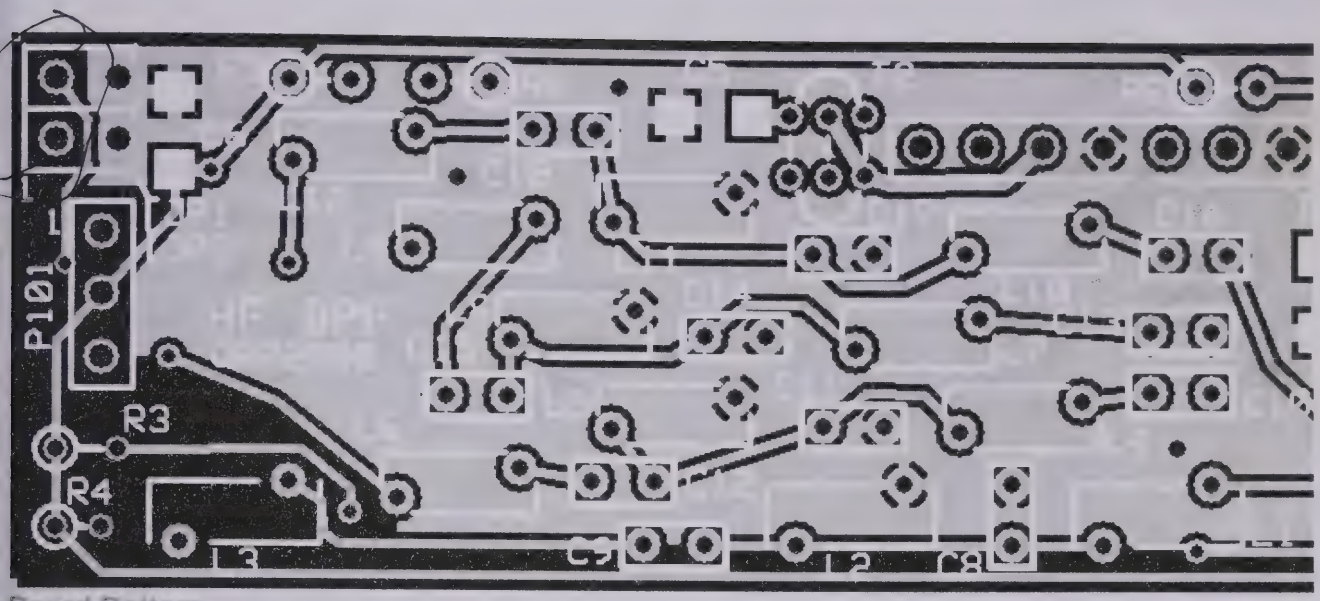
6-4 MHz — 4-8 — 8-16 — 16-30

T1 input xfmr — T2 output xfmr

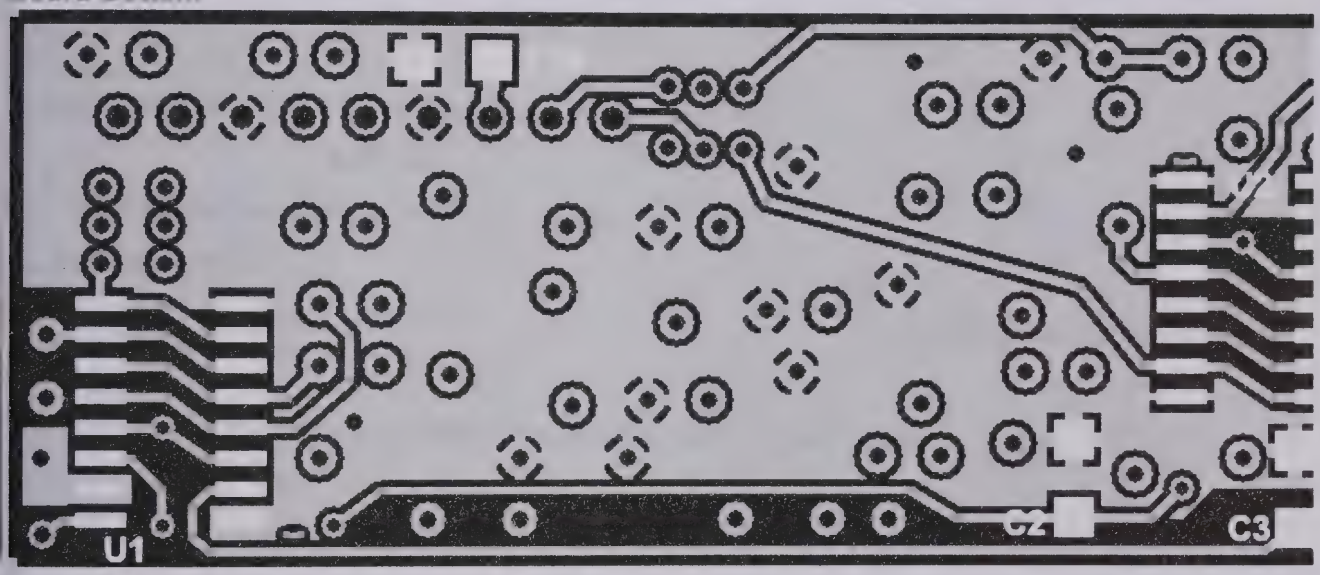
Please turn

to 23

021 V966



Board Bottom



- Install all SMT and SOIC components to the bottom of the board, then the top of the board
- Wind and install the transformers
- Wind and install the Coils
- Install the ceramic capacitors
- Install the resistors
- Install the jumpers and connectors

Project Detailed Build Notes

For the non-expert builders among us, this site takes you through a stage-by-stage build of the kit. Each stage is self-contained and outlines the steps to build and test the stage. This ensures that you will have a much better chance of success once you reach the last step, since you will have successfully built and tested each preceding stage before moving on to the next stage.

Each stage is listed below, in build order, and you can link to it by clicking on its name below (or in the header and/or footer of each web page).

- Inventory the
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage
- Build and Test the Stage

Background Info

Tools

Winding Inductors

To learn how to wind coils and transformers, please read the

- and then
- view the excellent videos on
- or take a read of
- You can review the for details on toroidal and binocular inductors.

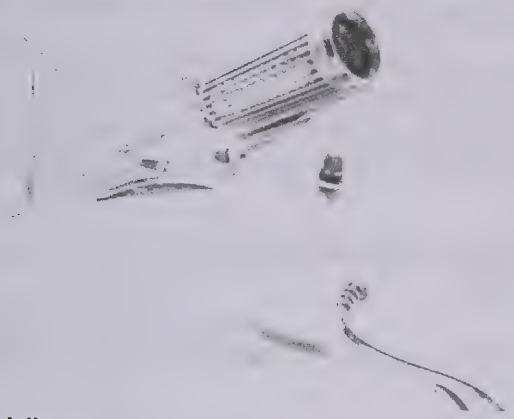
Soldering

The video below describes techniques for soldering SOIC 14 (and 16 and 8) SMDs

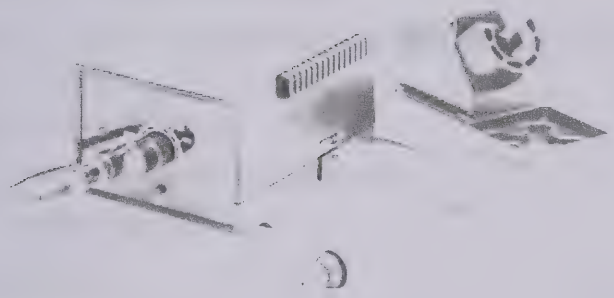
Read the at the Sparkfun site. It is a very good read and it speaks

great truths. Then take the time to watch the

- . Don't skimp here. Soldering deficiencies account for 80 percent of the problems surfaced in troubleshooting. It is preferable to have an ESD-safe station, with a grounded tip. A couple of good stations that are relatively inexpensive are:



- Velleman (approx $20 at Frys)



- Harbor Freight

ESD Protection

- Avoid carpets in cool, dry areas.
- Leave PC cards and memory modules in their anti-static packaging until ready to be installed.
- Dissipate static electricity before handling any system components (PC cards, memory modules) by touching a grounded metal object, such as the system unit unpainted metal chassis.
- If possible, use antistatic devices, such as (see for $25 or the for $15)).
- Always hold a PC card or memory module by its edges. Avoid touching the contacts and components on the memory module.
- Before removing chips from insulator, put on the wrist strap connected to the ESD mat. All work with CMOS chips should be done with the wrist strap on.
- As an added precaution before first touching a chip, you should touch a finger to a grounded metal surface.
- If using a DMM, its outside should be in contact with the ground of the ESD mat, and both leads shorted to this ground before use.

- See the review of ESD Precautions at this .

Work Area

- You will need a well-lit work area and a minimum of 3X magnification (the author uses a cheap magnifying fluorescent light with a 3X lens. This is supplemented by a hand-held 10 X loupe - with light - for close-in inspection of solder joints and SMT installation.
- You should use a cookie sheet or baking pan (with four sides raised approximately a half an inch) for your actual work space. It is highly recommended for building on top of in order to catch stray parts, especially the tiny SMT chips which, once they are launched by an errant tweezer squeeze, are nigh on impossible to find if they are not caught on the cookie sheet.

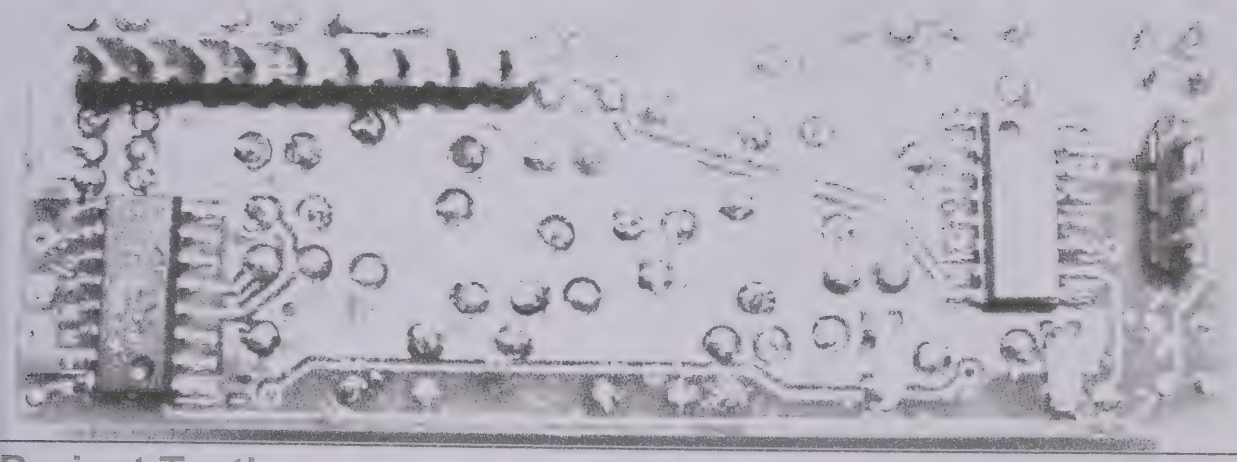
Misc Tools

- It is most important to solidly clamp the PCB in a holder when soldering. A "third-hand" (e.g., or the) can hold your board while soldering. In a pinch, you can get by with a simple . Jan G0BBL suggests "A very cheap way is to screw a Large Document Clip to a woodblock which will clamp the side of a PCB."
-
- Tweezers (bent tip is preferable).
- A toothpick and some beeswax - these can be used to pickup SMT devices and hold them steady while soldering.
- Diagonal side cutters.
- Small, rounded jaw needle-nose pliers.
- Set of jewelers' screwdrivers
- An Exacto knife.
- Fine-grit emery paper.

Project Completed Stage

Top of the Board

Bottom of the Board



Project Testing

Each stage will have a "Testing" Section, outlining one or more tests that, when successfully completed, provide you with the confidence and assurance that you are heading in the right direction towards a fully tested and built transceiver.

When you perform a test, you should always record the results of the test where indicated in the Testing section. This will make troubleshooting via the reflector much easier, since you will be communicating with the experts using a standard testing and measurement regime.

It goes without saying that you should ALWAYS precede any tests with a very careful, minute inspection (using the best light and magnification available to you) to be sure all solder joints are clean and there are no solder bridges or cold joints.

HF BPF 08_Band1a 6m

Search: Search selected SDR sites

Band1a 6m Introduction

General

The latest design of the HF-BPF kit now permits of two options:

- Option 1: the original design covering 1.8 MHz - 30 mHz, in 4 bands, and
- Option 2: a board covering 3.5 MHz - 30 MHz plus 6m, in 4 bands

These builders notes describe 4 "bands" and the board layout permits filters for four bands. However, depending upon the option (1 or 2), the bands named "band 1" and "band 2" will be built and installed differently. The changes for Band 1 are as follows (and will be implmented somewhat more elegantly in these note, time and resources permitting):

- Band 1 is changed between option 1 (1.8-4 MHz) and option 2 (6m):
  - C7: option 1=150 pF; option 2 = 5.6 pF
  - C8: option 1=330 pF ; option 2 = 39 pF
  - C9: option 1=150 pF ; option 2 = 5.6 pF
  - L1: option 1= 23 uH ; option 2 = 1.64 uH
  - L2: option 1= 10.7uH; option 2 = not used
  - L3: option 1= 23 uH ; option 2 = 1.64 uH

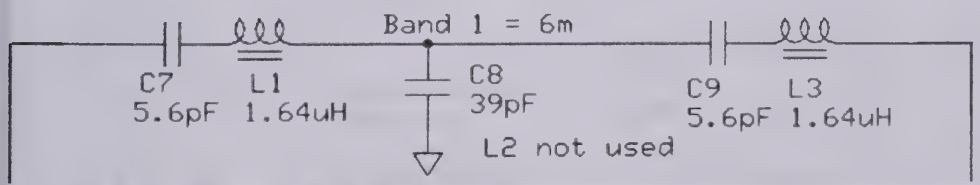
See the

)

Band1a 6m Schematic

Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)

)



( )

Band1a 6m Bill of Materials

Stage Bill of Materials

Resistor images and color codes courtesy of 's)

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
	C07	5.6 pF 5%	5.6	Ceramic			Band1a 6m

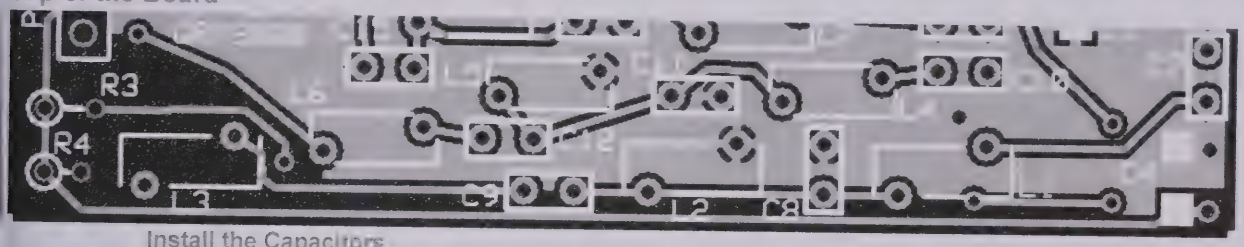
❑	L1	1.64 uH 23T #30 on T25-6 (15")	yellow	Coil			Band1a 6m
❑	C09	5.6 pF 5%	5.6	Ceramic			Band1a 6m
❑	L3	1.64 uH 23T #30 on T25-6 (15")	yellow	Coil			Band1a 6m
❑	L2	unused capacitor		Unused			Band1a 6m
❑	C08	39pF 5%	39J	Ceramic			Band1a 6m

Band1a 6m Summary Build Notes

- Install the Capacitors
- Wind and Install the Coils
-

Band1a 6m Detailed Build Notes

Top of the Board



Install the Capacitors

Check	Designation	Component	Marking	Category	Orientation	Notes
❑	C07	5.6 pF 5%	5.6	Ceramic		
❑	C09	5.6 pF 5%	5.6	Ceramic		
❑	C08	39pF 5%	39J	Ceramic		

Wind and Install the Coils

Check	Designation	Component	Marking	Category	Orientation	Notes
❑	L1	1.64 uH 23T #30 on T25-6 (15")	yellow	Coil		
❑	L3	1.64 uH 23T #30 on T25-6 (15")	yellow	Coil		
❑	L2	unused capacitor		Unused		

Band1a 6m Completed Stage

op of the Board

ew of Completed Top

Band1a 6m Testing

isual Inspection

est Setup

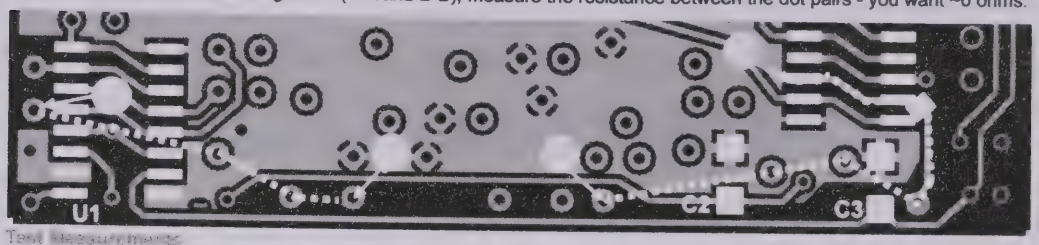
Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the inductors. If necessary, touch up the joints with your iron and/or some flux.

Continuity Tests

Test Setup

- This tests for continuity in the "chain" of inductors for this band
- The graphic below shows two continuity chains and their associated test points on the bottom of the board.
- The "A and B chains"are shown using lettered dots and lines. :
- For each of the two segments (A-A and B-B), measure the resistance between the dot pairs - you want ~0 ohms.



Test Measurements

Measure	Units	Nominal Value	Actual's	Notes
Point "A" to poin "A"t	ohms	0	TBD	
Point "A" to poin "A"t	ohms	0	TBD	

HF BPF 03_Transformers

Search: Search selected SDR sites

Transformers Introduction

General

n this stage, you wind the input and output transformers that are, respectively, in front of and following the two switches.

Following the installation of the transformers, you will validate their connection/soldering with a series of continuity tests and then you will validate the functioning of the two switches through a series of voltage tests and jumper settings.

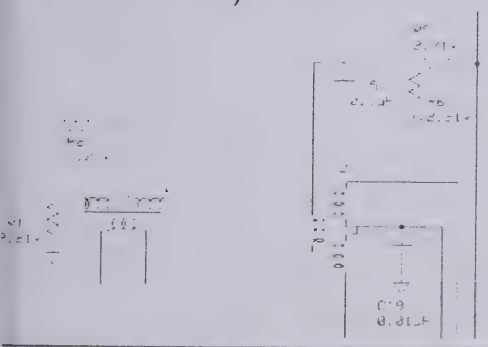
You may want to review the

)

Transformers Schematic

Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)

)



( )

Transformers Bill of Materials

Stage Bill of Materials

Resistor images and color codes courtesy of 's)

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
	T1 wire	#30 enameled magnetic wire		Misc		3 lengths of #30, each 7" (18cm) long, should do OK	Transformers
	T2 wire	#30 enameled magnetic wire		Misc		primary: one 10" (25 cm) length; secondaries: two 5" (12.5 cm) length should do OK	Transformers
	T2	8T/2T bifilar BN43-2402 (10")		Xfrmr			Transformers
	T1	4T #30 trifilar BN43-2402 (7")		Xfrmr			Transformers
	T1-core	BN-43-2402		Binocular core			Transformers

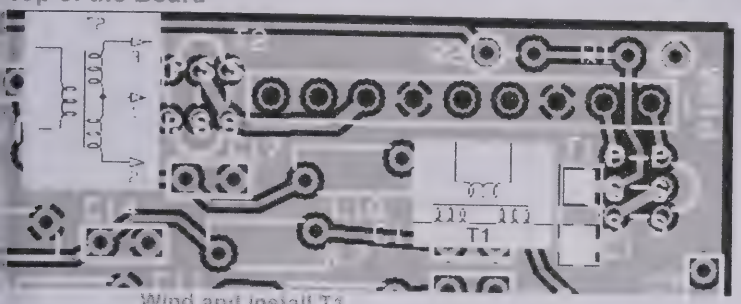
❑	T2-core	BN-43-2402		Binocular core		Transformers

Transformers Summary Build Notes

- Wind and install T1
- Wind and install T2
-

Transformers Detailed Build Notes

Top of the Board

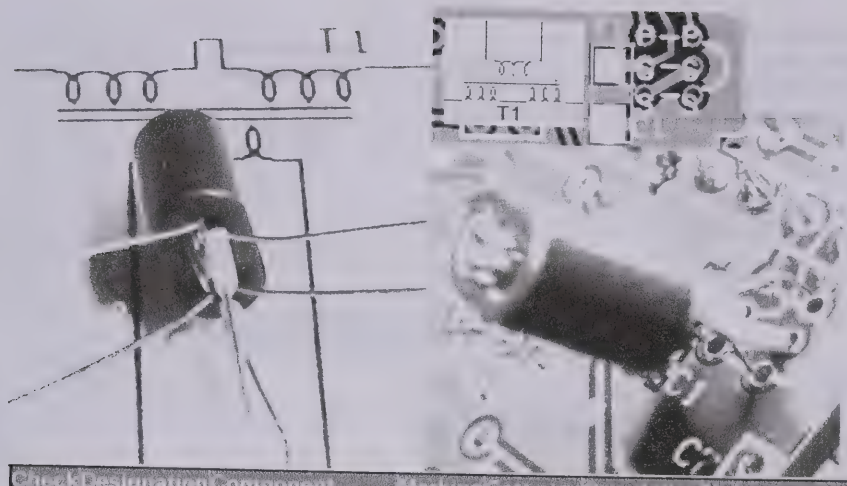


Wind and install T1

WB5RVZ SDR
(Home page

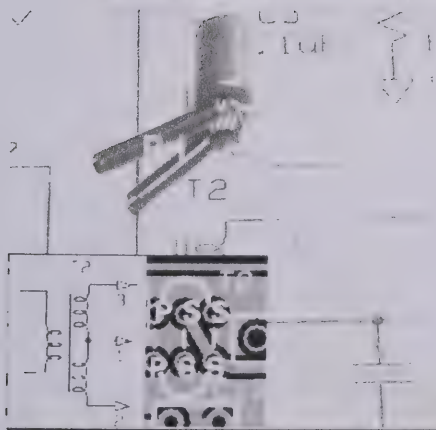
HF multiband BPF
kit (for UAO rx)
30 June 2010

One Turn



Check	Designation	Component	Marking	Category	Orientation	Notes
☐	T1 wire	#30 enameled magnetic wire		Misc		3 lengths of #30, each 7" (18cm) long, should do OK
☐	T1	4T #30 trifilar BN43-2402 (7")		Xfrmr		

Wind and install T2

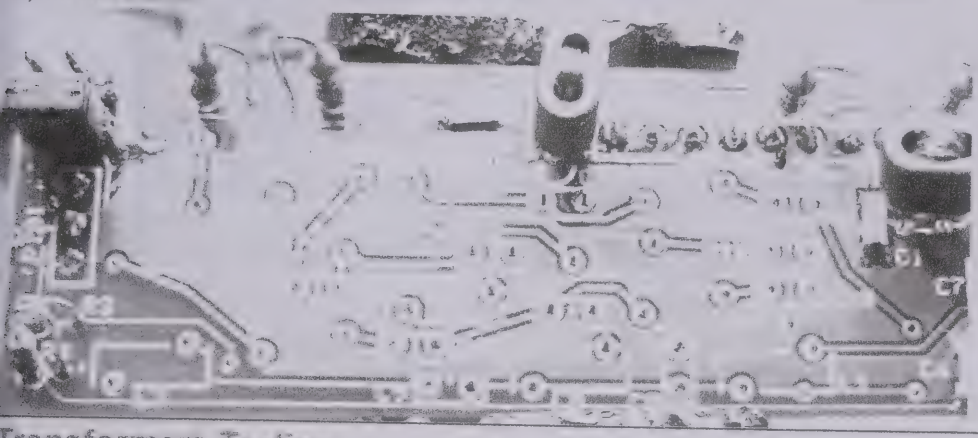


Check	Designation	Component	Marking	Category	Orientation	Notes

☐	T2 wire	#30 enameled magnetic wire		Misc		primary: one 10" (25 cm) length; secondaries: two 5" (12.5 cm) length should do OK
☐	T2	8T/2T bifilar BN43-2402 (10")		Xfrmr		

Transformers Completed Stage

Top of the Board



Transformers Testing

Visual Check

Test Setup

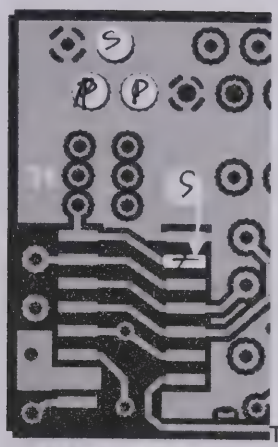
Before condiucting the continuity tests below, using good light and magnification, conduct a thorough visual check of the transformer leads' solder joints, looking carefully for cold solder joints.

Soldering defects are the most common causes of transformers not working correctly

Test Setup

Take ESD precautions in the secondary windings' tests

- This tests the installation and soldering of the leads for T1 by testing for continuity between points on the bottom of the board which are connected via traces to the appropriate leads of T1
- The test points for the primary winding are marked "P"; the test points for the secondaries are marked "S".
- The primary winding testpoints correspond to pins 1 and 2 of P100 (the antenna input into the board). T1 is right at the antenna input and looks like a DC short. The BPF individual modules use capacitive coupling to the transformer for part of the filtering so they look open (to DC). Thanks to Mike Collins KF4BQ and Daniel Lagerblad for this note.



Test T1 Continuity"

Test Measurements

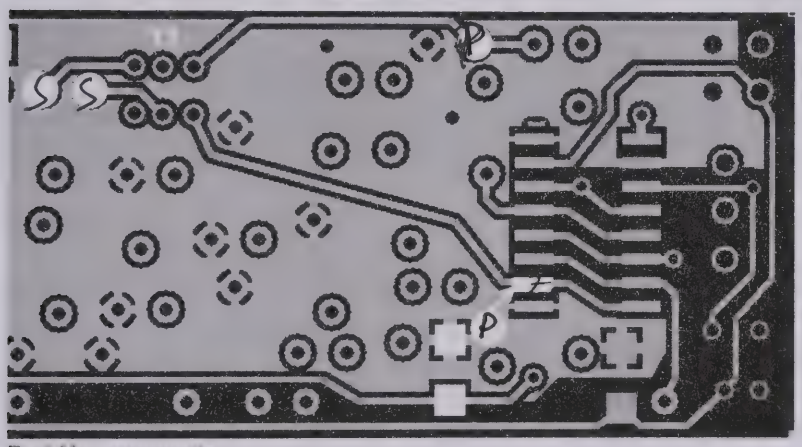
Testpoint	Units	Nominal Value	Author's	Yours
Resistance between P and P (Pri; see above)	ohms	0	0	
Resistance between points S and S (sec)	ohms	0	0	

Test T2 Continuity

Test Setup

Take ESD precautions in the primary windings' tests

- This tests the installation and soldering of the leads for T2 by testing for continuity between points on the bottom of the board which are connected via traces to the appropriate leads of T2
- The test points for the primary winding are marked "P"; the test points for the secondaries are marked "S".



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Resistance between P and P (Pri; see above)	ohms	0	0	
Resistance between points S and S (sec)	ohms	0	0	

SwitchingTest

Test Setup

This test validates whether the switches are switching correctly for the four different settings of JP1 and JP2.

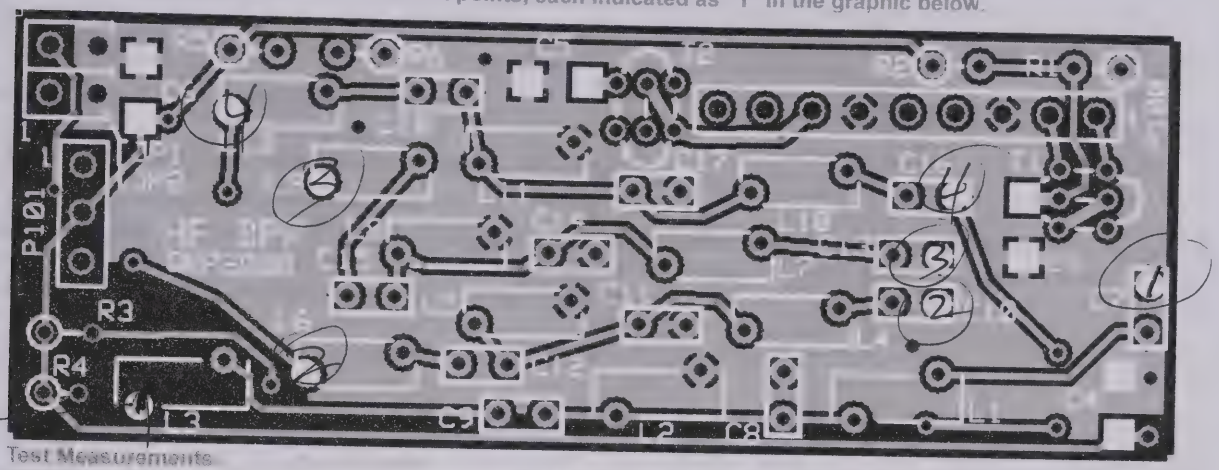
In each switch, the switched path has approximately 2.5 Vdc available at the two voltage dividers (R1/R2, and R5/R6). Thus, we can test for correct switching by measuring the voltage with respect to ground at each of the test points for U1 and U2.

Testpoints on each successfully switched path will measure 50% of the +5 V power rail

Testpoints on non-switched paths will measure less than 1 Vdc..

Test Setup

- Plug the HF-BPF board into the jacks on the V9.0 board (to get power to the HF-BPF board)
- Apply power to the V9.0 board
- Connect the DMM's COM lead to a ground point
- Measure the voltage with respect to ground of each of the two testpoints for the path chosen (expect 2.5 V on chosen path, < 1 Vdc for other paths)
- For example, path 1 has two test points, each indicated as "1" in the graphic below.



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
JP1 and JP2 closed - measure testpoint 1 (at L3)	Vdc	2.5	2.48	
JP1 and JP2 closed - measure testpoint 1 (at C7)	Vdc	2.5	2.48	
JP1 Open, JP2 Closed - measure testpoint 2 (at L6)	Vdc	2.5	2.48	
JP1 Open, JP2 Closed - measure testpoint 2 (at C10)	Vdc	2.5	2.48	
JP1 Closed, JP2 Open - measure testpoint 3 (at L9)	Vdc	2.5	2.48	
JP1 Closed, JP2 Open - measure testpoint 3 (at C13)	Vdc	2.5	2.48	
JP1 Open, JP2 Open - measure testpoint 4 (at L12)	Vdc	2.5	2.48	
JP1 Open, JP2 Open - measure testpoint 4 (at C16)	Vdc	2.5	2.48	

HF BPF 04_Band 1: 1.8-4 MHz

Search: Search selected SDR sites

Band 1: 1.8-4 MHz Introduction

General

The latest design of the HF-BPF kit now permits of two options:

- Option 1: the original design covering 1.8 MHz - 30 mHz, in 4 bands, and
- Option 2: a board covering 3.5 MHz - 30 MHz plus 6m, in 4 bands

These builders notes describe 4 "bands" and the board layout permits filters for four bands. However, depending upon the option (1 or 2), the bands named "band 1" and "band 2" will be built and installed differently. The changes for Band 1 are as follows (and will be implmented somewhat more elegantly in these note, time and resources permitting):

- Band 1 is changed between option 1 (1.8-4 MHz) and option 2 (6m):
  - C7: option 1=150 pF; option 2 = 5.6 pF
  - C8: option 1=330 pF ; option 2 = 39 pF
  - C9: option 1=150 pF ; option 2 = 5.6 pF
  - L1: option 1= 23 uH ; option 2 = 1.64 uH
  - L2: option 1= 10.7uH; option 2 = not used
  - L3: option 1= 23 uH ; option 2 = 1.64 uH

See the

This stage builds and installs the filter "chain" for Band 1. Refer to EPBBL to see the performance characteristics of this chain.

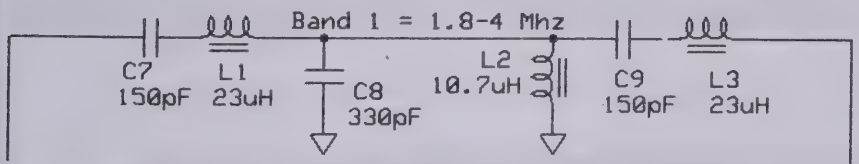
Remember, when winding toroidal inductors, a single pass through the core counts as 1 turn. You might want to review on winding toroidal coils.

( )

Band 1: 1.8-4 MHz Schematic

(Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)

( )



( )

Band 1: 1.8-4 MHz Bill of Materials

Stage Bill of Materials

(resistor images and color codes courtesy of 's)

Check	Designation	Component	Marking	Category	Orientation	Notes	Status
☐	L1-core	T30-2 toroid core	red 	Toroid			Band 1: 1.8-4 MHz

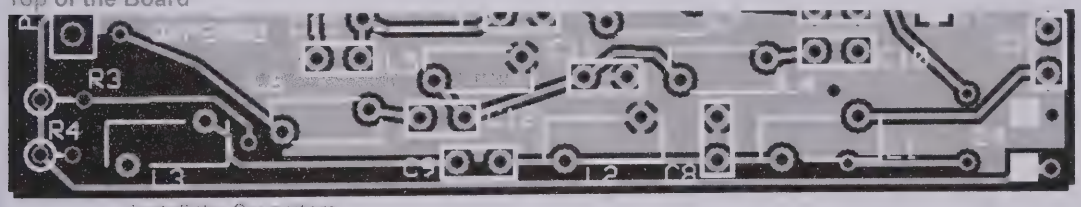
❑	L2-core	T30-2 toroid core	red	Toroid			Band 1: 1.8-4 MHz
❑	L3-core	T30-2 toroid core	red	Toroid			Band 1: 1.8-4 MHz
❑	wire 1	#30 enameled magnetic wire		Misc			Band 1: 1.8-4 MHz
❑	C09	150 pF 5%	151	Ceramic			Band 1: 1.8-4 MHz
❑	C07	150 pF 5%	151	Ceramic			Band 1: 1.8-4 MHz
❑	L1	23 uH 71T #30 on T30-2 (39")	red	Coil			Band 1: 1.8-4 MHz
❑	L3	23 uH 71T #30 on T30-2 (39")	red	Coil			Band 1: 1.8-4 MHz
❑	C08	330 pF 5%	331	Ceramic			Band 1: 1.8-4 MHz
❑	L2	10.7 uH 50T #30 on T30-2 (28")	red	Coil			Band 1: 1.8-4 MHz

Band 1: 1.8-4 MHz Summary Build Notes

- Install the Capacitors
- Wind and Install the Coils
-

Band 1: 1.8-4 MHz Detailed Build Notes

Top of the Board

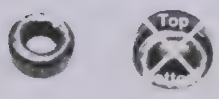


Install the Capacitors

Check	Designation	Component	Marking	Category	Orientation	Notes
❑	C09	150 pF 5%	151	Ceramic		
❑	C07	150 pF 5%	151	Ceramic		

☐	C08	330 pF 5%	331	Ceramic		

Wind and Install the Coils



hairpin

Winding2

Winding 2

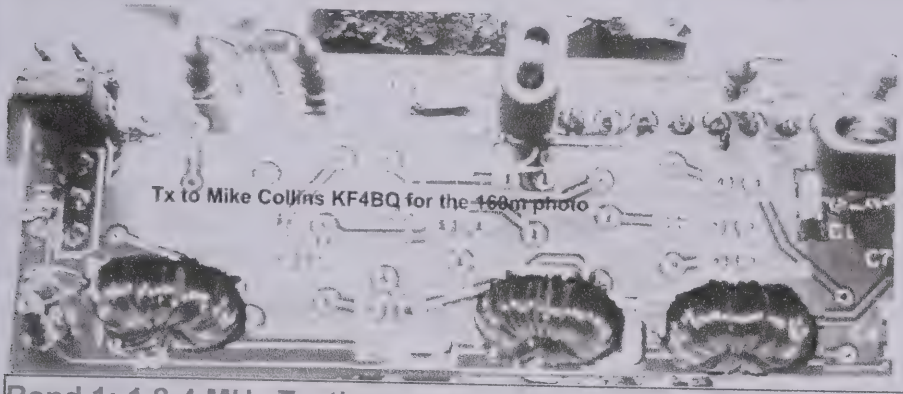
Winding 2 Winding 2

Check	Designation	Component	Material	Category	Orientation	Value
☐	wire 1	#30 enameled magnetic wire		Misc		
☐	L1	23 uH 71T #30 on T30-2 (39")	red	Coil		
☐	L3	23 uH 71T #30 on T30-2 (39")	red	Coil		

☐	L2	10.7 uH 50T #30 on T30-2 (28")	red 	Coil		

Band 1: 1.8-4 MHz Completed Stage

Top of the Board



Band 1: 1.8-4 MHz Testing

Visual Check

Test Setup

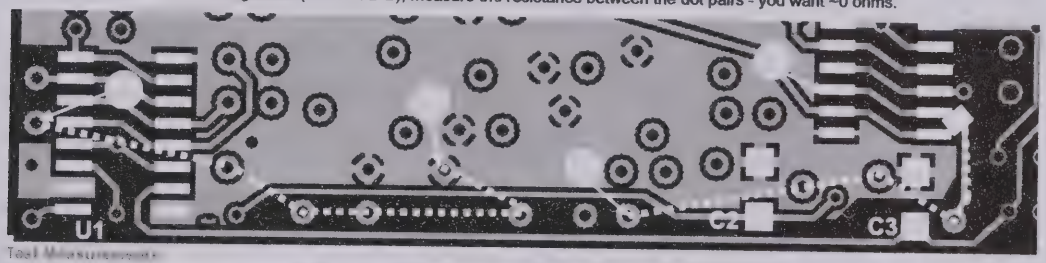
Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the inductors. If necessary, touch up the joints with your iron and/or some flux.

Continuity Tests

Test Setup

- This tests for continuity in the "chain" of inductors for this band
- The graphic below shows two continuity chains and their associated test points on the bottom of the board.
- The "A and B chains"are shown using lettered dots and lines. :
- For each of the two segments (A-A and B-B), measure the resistance between the dot pairs - you want ~0 ohms.



Test Measurements

Test Point	Units	Nominal Value	Approved	Value
Point A to Point A	ohms	0	0	
Point B to Point B	ohms	0	0	

HF BPF 05_Band 2: 4-8 MHz

Search: Search selected SDR sites

Band 2: 4-8 MHz Introduction

General

The latest design of the HF-BPF kit now permits of two options:

- Option 1: the original design covering 1.8 MHz - 30 mHz, in 4 bands, and
- Option 2: a board covering 3.5 MHz - 30 MHz plus 6m, in 4 bands

These builders notes describe 4 "bands" and the board layout permits filters for four bands. However, depending upon the option (1 or 2), the bands named "band 1" and "band 2" will be built and installed differently. The changes for Band 2 are as follows (and will be implmented somewhat more elegantly n these note, time and resources permitting):

- Band 2 is changed between option 1 (4-8 MHz) and option 2 (3.5-8MHz):
  - C10: option 1=100 pF; option 2 = 120 pF
  - C11: option 1=390 pF ; option 2 = 270 pF
  - C12: option 1=100 pF ; option 2 = 120 pF
  - L4: unchanged
  - L5: option 1= 2.1 uH ; option 2 = 3.5 uH
  - L6: unchanged

See the

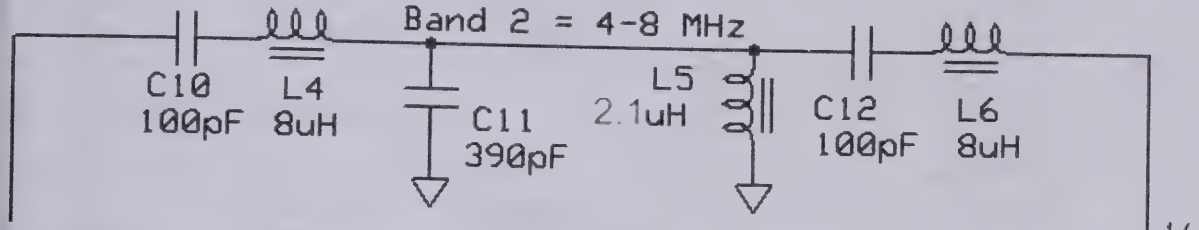
his stage builds and installs the filter "chain" for Band 2. Refer to to see ne performance characteristics of this chain.

Remember, when winding toroidal inductors, a single pass through the core counts as 1 urn. You might want to review on winding toroidal oils.

)

Band 2: 4-8 MHz Schematic

(Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)



Band 2: 4-8 MHz Bill of Materials

Stage Bill of Materials

(resistor images and color codes courtesy of 's)

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	L4-core	T25-2 toroid core	red	Toroid			Band 2: 4-8 MHz
❑	L5-core	T25-2 toroid core	red	Toroid			Band 2: 4-8 MHz
❑	L6-core	T25-2 toroid core	red	Toroid			Band 2: 4-8 MHz
❑	wire 2	#30 enameled magnetic wire		Misc			Band 2: 4-8 MHz
❑	C10	100 pF 5%	101	Ceramic			Band 2: 4-8 MHz
❑	L5	2.1 uH 24T #30 0n T25-2 (14")	red	Coil			Band 2: 4-8 MHz
❑	C12	100 pF 5%	101	Ceramic			Band 2: 4-8 MHz

❑	L6	8 uH 49T #30 on T25-2 (22")	red	Coil			Band 2: 4-8 MHz
❑	C11	390 pF 5%	391	Ceramic			Band 2: 4-8 MHz
❑	L4	8 uH 49T #30 on T25-2 (22")	red	Coil			Band 2: 4-8 MHz

Band 2: 4-8 MHz Summary Build Notes

- Install the Capacitors
- Wind and Install the Coils
-

Band 2: 4-8 MHz Detailed Build Notes

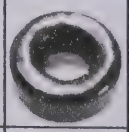
Top of the Board

Install the Capacitors

[illegible]

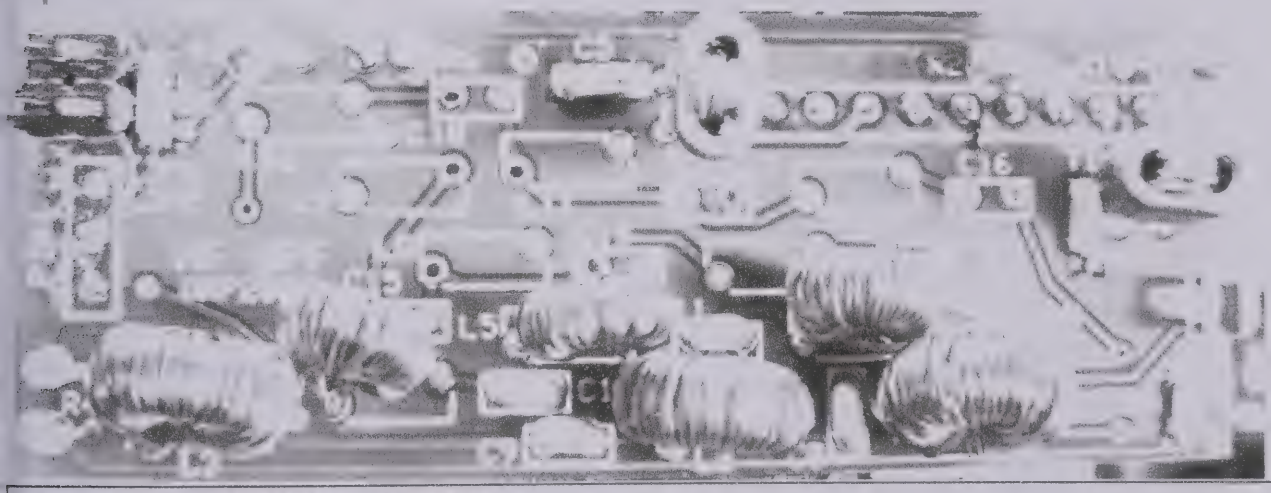
Check	Designation	Component	Marking	Category	Orientation	Notes
❑	C10	100 pF 5%	101	Ceramic		
❑	C12	100 pF 5%	101	Ceramic		
❑	C11	390 pF 5%	391	Ceramic		

Wind and Install the Coils

Check	Designation	Component	Marking	Category	Orientation	Notes
☐	wire 2	#30 enameled magnetic wire		Misc		
☐	L5	2.1 uH 24T #30 0n T25-2 (14")	red 	Coil		
☐	L6	8 uH 49T #30 on T25-2 (22")	red 	Coil		
☐	L4	8 uH 49T #30 on T25-2 (22")	red 	Coil		

Band 2: 4-8 MHz Completed Stage

Top of the Board



Band 2: 4-8 MHz Testing

Visual Check

Test Setup

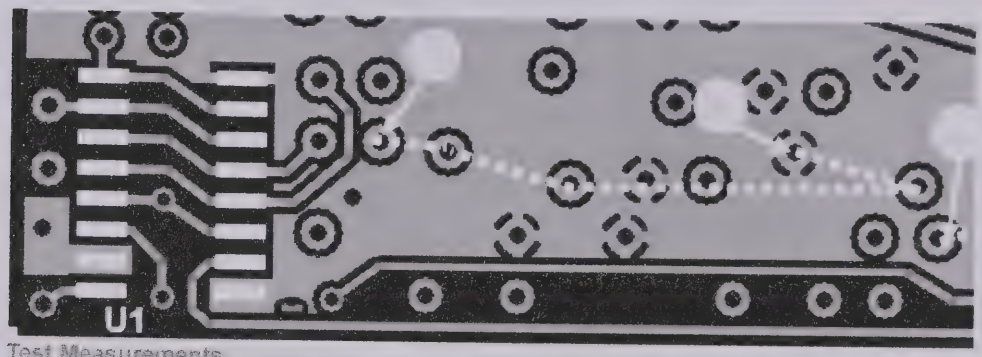
Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold oints, or poor contacts.

Pay especial attention to the joints on the inductors. If necessary, touch up the joints with your iron and/or some flux.

Continuity Tests

Test Setup

- This tests for continuity in the "chain" of inductors for this band
- The graphic below shows two continuity chains and their associated test points on the bottom of the board.
- The "A and B chains"are shown using lettered dots and lines. :
- For each of the two segments (A-A and B-B), measure the resistance between the dot pairs - you want ~0 ohms.



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Point A to Point A	ohms	0	0	
Point B to Point B	ohms	0	0	

HF BPF 06_Band 3: 8-16 MHz

Search: Search selected SDR sites

Band 3: 8-16 MHz Introduction

General

See the

This stage builds and installs the filter "chain" for Band 3. Refer to to see the performance characteristics of this chain.

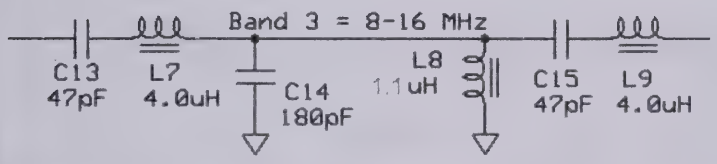
Remember, when winding toroidal inductors, a single pass through the core counts as 1 turn. You might want to review on winding toroidal coils.

( )

Band 3: 8-16 MHz Schematic

(Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)

( )



( )

Band 3: 8-16 MHz Bill of Materials

Stage Bill of Materials

(resistor images and color codes courtesy of 's)

Checked	Designation	Component	Marking	Category	Orientation	Mode	Circuit
❑	L7-core	T25-6 toroid core	yellow	Toroid			Band 3: 8-16 MHz
❑	L8-core	T25-6 toroid core	yellow	Toroid			Band 3: 8-16 MHz
❑	L9-core	T25-6 toroid core	yellow	Toroid			Band 3: 8-16 MHz
❑	wire 3	#30 enameled magnetic wire		Misc			Band 3: 8-16 MHz
❑	C13	47 pF 5%	47J	Ceramic			Band 3: 8-16 MHz
❑	L7	4 uH 38T #30 on T25-6 (18")	yellow	Coil			Band 3: 8-16 MHz
❑	L9	4 uH 38T #30 on T25-6 (18")	yellow	Coil			Band 3: 8-16 MHz

❑	C14	180 pF 5%	181	Ceramic			Band 3: 8-16 MHz
❑	C15	47 pF 5%	47J	Ceramic			Band 3: 8-16 MHz
❑	L8	1.1 uH 20T #30 on T25-6 (11")	yellow	Coil			Band 3: 8-16 MHz

Band 3: 8-16 MHz Summary Build Notes

- Install the Capacitors
- Wind and Install the Coils
-

Band 3: 8-16 MHz Detailed Build Notes

Top of the Board

Install the Capacitors

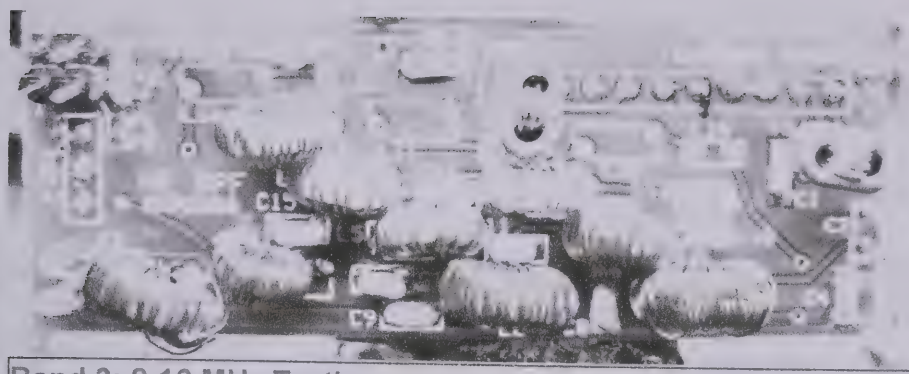
Check	Designation	Component	Marking	Category	Orientation	Notes
❑	C13	47 pF 5%	47J	Ceramic		
❑	C14	180 pF 5%	181	Ceramic		
❑	C15	47 pF 5%	47J	Ceramic		

Wind and Install the Coils

Check	Designation	Component	Marking	Category	Orientation	Notes
❑	wire 3	#30 enameled magnetic wire		Misc		
❑	L7	4 uH 38T #30 on T25-6 (18")	yellow	Coil		
❑	L9	4 uH 38T #30 on T25-6 (18")	yellow	Coil		
❑	L8	1.1 uH 20T #30 on T25-6 (11")	yellow	Coil		

Band 3: 8-16 MHz Completed Stage

Top of the Board



Band 3: 8-16 MHz Testing

Visual Check

Test Setup

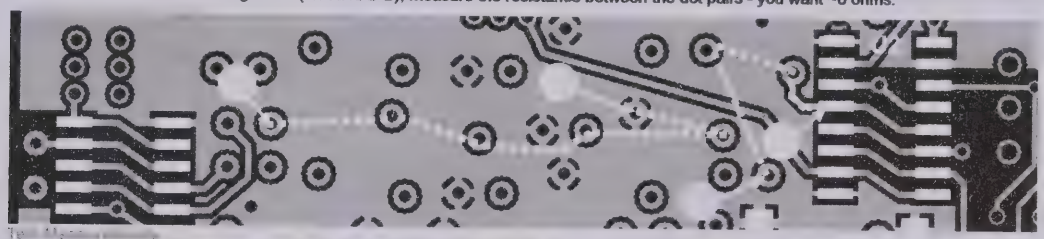
Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the inductors. If necessary, touch up the joints with your iron and/or some flux.

Continuity Tests

Test Setup

- This tests for continuity in the "chain" of inductors for this band
- The graphic below shows two continuity chains and their associated test points on the bottom of the board.
- The "A and B chains"are shown using lettered dots and lines. :
- For each of the two segments (A-A and B-B), measure the resistance between the dot pairs - you want ~0 ohms.



Test Measurements

Test Point	Units	Nominal Value	Minimum	Actual
Point A to Point A	ohms	0	0	
Point B to Point B	ohms	0	0	

HF BPF 07_Band 4: 16-30 MHz

Search: Search selected SDR sites

Band 4: 16-30 MHz Introduction

General

See the

This stage builds and installs the filter "chain" for Band 4. Refer to to see the performance characteristics of this chain.

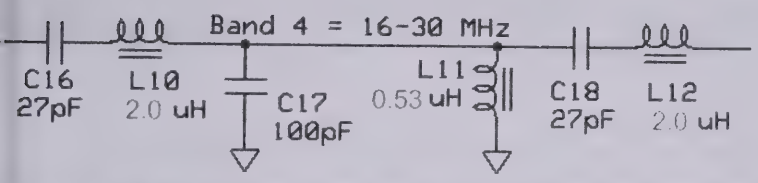
Remember, when winding toroidal inductors, a single pass through the core counts as 1 turn. You might want to review on winding toroidal coils.

)

Band 4: 16-30 MHz Schematic

Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)

)



( )

Band 4: 16-30 MHz Bill of Materials

Stage Bill of Materials

Resistor images and color codes courtesy of 's)

Stock	Designation	Component	Marking	Category	Orientation	Notes	Circuit
	L10-core	T25-6 toroid core	yellow	Toroid			Band 4: 16-30 MHz
	L11-core	T25-6 toroid core	yellow	Toroid			Band 4: 16-30 MHz
	L12-core	T25-6 toroid core	yellow	Toroid			Band 4: 16-30 MHz
	wire 4	#30 enameled magnetic wire		Misc			Band 4: 16-30 MHz
	C16	27 pF 5%	27J	Ceramic			Band 4: 16-30 MHz

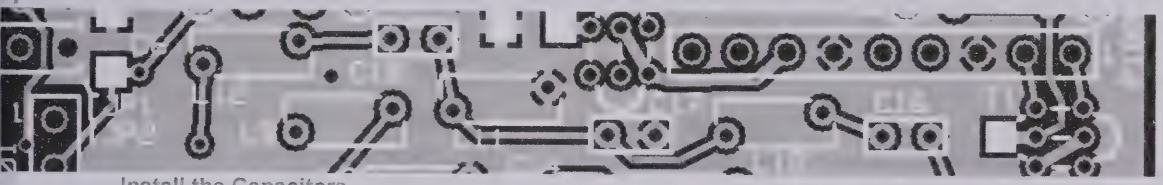
☐	L12	2 uH 27T #30 on T25-6 (16")	yellow	Coil			Band 4: 16-30 MHz
☐	C17	100 pF 5%	101	Ceramic			Band 4: 16-30 MHz
☐	L10	2 uH 27T #30 on T25-6 (16")	yellow	Coil			Band 4: 16-30 MHz
☐	C18	27 pF 5%	27J	Ceramic			Band 4: 16-30 MHz
☐	L11	0.53 uH 14T #30 on T25-6 (10")	yellow	Coil			Band 4: 16-30 MHz

Band 4: 16-30 MHz Summary Build Notes

- Install the Capacitors
- Wind and Install the Coils
-

Band 4: 16-30 MHz Detailed Build Notes

op of the Board



Install the Capacitors

Check	Designation	Component	Marking	Category	Orientation	Notes
☐	C16	27 pF 5%	27J	Ceramic		
☐	C17	100 pF 5%	101	Ceramic		
☐	C18	27 pF 5%	27J	Ceramic		

Wind and Install the Coils

Check	Designation	Component	Marking	Category	Orientation	Notes
☐	wire 4	#30 enameled magnetic wire		Misc		
☐	L12	2 uH 27T #30 on T25-6 (16")	yellow	Coil		
☐	L10	2 uH 27T #30 on T25-6 (16")	yellow	Coil		
☐	L11	0.53 uH 14T #30 on T25-6 (10")	yellow	Coil		

Band 4: 16-30 MHz Completed Stage

Top of the Board

Band 4: 16-30 MHz Testing

Visual Check

Test Setup

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the inductors. If necessary, touch up the joints with your iron and/or some flux.

Continuity Tests

Test Setup

- This tests for continuity in the "chain" of inductors for this band
- The graphic below shows two continuity chains and their associated test points on the bottom of the board.
- The "A and B chains"are shown using lettered dots and lines. :
- For each of the two segments (A-A and B-B), measure the resistance between the dot pairs - you want ~0 ohms.

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Point A to Point A	ohms	0	0	
Point B to Point B	ohms	0	0	

Chet. Swidell BPF Coil Data, etc

HF BPF 00_Bill of Materials

2(80) 3(80) 4(15) 4-8 8-16 16-30

Choice #1

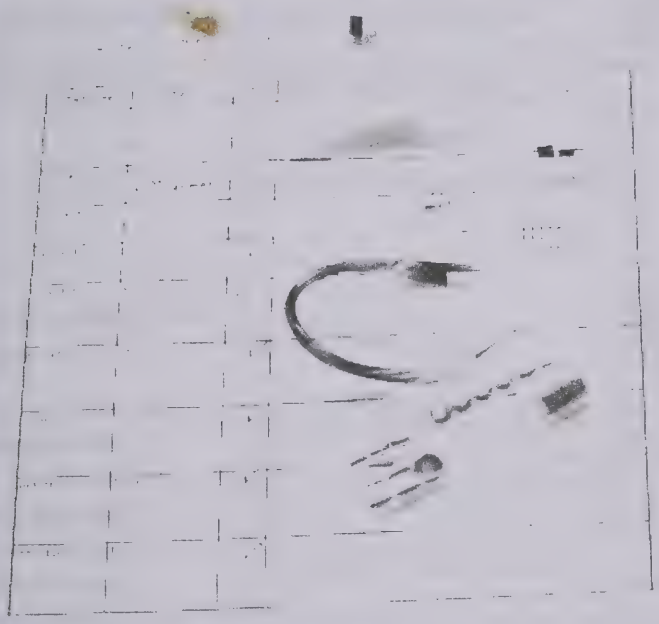
1(a) 2(a) 3(4) 4(1a) 6m 3.5-8 8-16 16-30

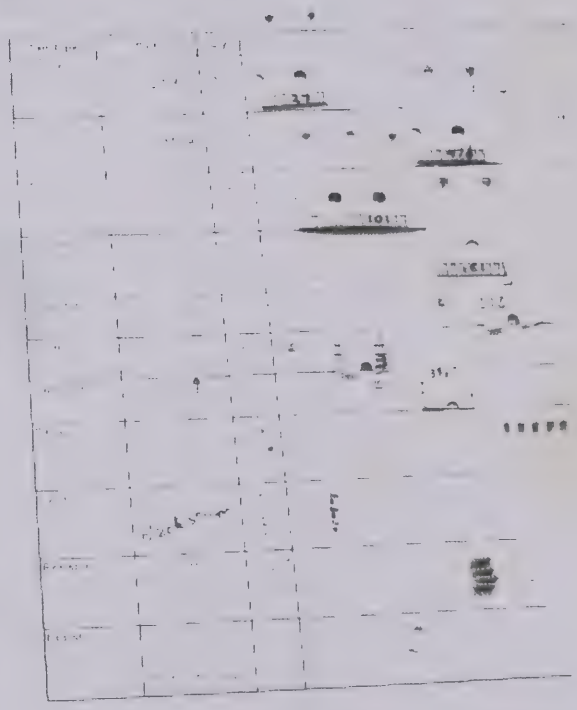
Choice #2

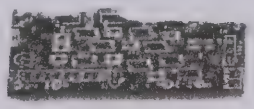
Bill of Materials Introduction

General

Inventory your kit before doing anything else. You may want to print out and use the to aid you in identifying and arranging the various components.



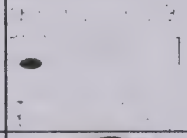
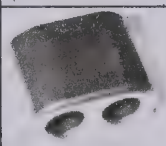




Bill of Materials

Component Inventory Summary

Component	Value	Markings	Quantity
Capacitor-Ceramic	5.6 pF 5%	5.6	2
Capacitor-Ceramic	27 pF 5%	27J	2
Capacitor-Ceramic	39pF 5%	39J	1
Capacitor-Ceramic	47 pF 5%	47J	2
Capacitor-Ceramic	100 pF 5%	101	3
Capacitor-Ceramic	120 pF 5%	121	2
Capacitor-Ceramic	150 pF 5%	151	2
Capacitor-Ceramic	180 pF 5%	181	1
Capacitor-Ceramic	270 pF 5%	271	1

Capacitor-Ceramic	330 pF 5%	331	1
Capacitor-Ceramic	390 pF 5%	391	1
Capacitor-SMT 1206	0.01 uF		5
Capacitor-SMT 1206	0.1 uF	black stripe	2
Capacitor-unused	not used		1
connector-header	header, 3-pin		1
connector-header	header, 9-pin		1
connector-jumper	header, 2-pin w/jumper		2
connector-socket	header,female, 2 pin		1
IC-SOIC-16	FST3253 mux/demux switch	FST3253 	2
Inductor-binocular core	BN43-2402		2
Inductor-coil	0.53 uH 14T #30 on T25-6 (10")	yellow	1
Inductor-coil	1.1 uH 20T #30 on T25-6 (11")	yellow	1
Inductor-coil	1.64 uH 23T #30 on T25-6 (15")	yellow	2
Inductor-coil	2 uH 27T #30 on T25-6 (16")	yellow	2
Inductor-coil	2.1 uH 24T #30 0n T25-2 (14")	red	1
Inductor-coil	3.5 uH 32T #30 on T25-2 (15")	red	1
Inductor-coil	4 uH 38T #30 on T25-6 (18")	yellow	2
Inductor-coil	8 uH 49T #30 on T25-2 (22")	red	4
Inductor-coil	10.7 uH 50T #30 on T30-2 (28")	red	1
Inductor-coil	23 uH 71T #30 on T30-2 (39")	red	2
Inductor-misc	#30enameled magnetic wire		6
Inductor-toroid	T25-2 toroid core	red 	3

nductor-toroid	T25-6 toroid core	yellow	6
nductor-toroid	T30-2 toroid core	red	3
nductor-transformer	4T #30 trifilar BN43-2402 (7")		1
nductor-transformer	8T/2T bifilar BN43-2402 (10")		1
Resistor-1/4W	2.21 k 1/4W 1%	r-r-br-br-br	4
Resistor-1/4W	4.7 k 1/4 W 5%	y-v-r-gl	2

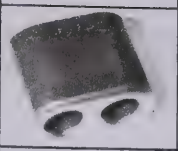
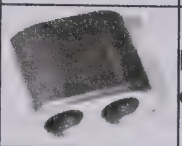
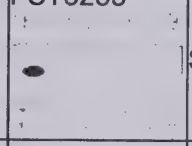
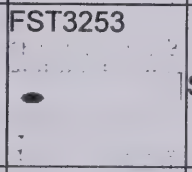
Detailed Bill of Materials

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
❑	C01	0.1 uF	black stripe	SMT 1206			Busses and Rails
❑	C02	0.01 uF		SMT 1206			Busses and Rails
❑	C03	0.01 uF		SMT 1206			Busses and Rails
❑	C04	0.01 uF		SMT 1206			Busses and Rails
❑	C05	0.1 uF	black stripe	SMT 1206			Busses and Rails
❑	C06	0.01 uF		SMT 1206			Busses and Rails
❑	C07	5.6 pF 5%	5.6	Ceramic			Band1a 6m
❑	C07	150 pF 5%	151	Ceramic			Band 1: 1.8-4 MHz
❑	C08	330 pF 5%	331	Ceramic			Band 1: 1.8-4 MHz
❑	C08	39pF 5%	39J	Ceramic			Band1a 6m
❑	C09	150 pF 5%	151	Ceramic			Band 1: 1.8-4 MHz
❑	C09	5.6 pF 5%	5.6	Ceramic			Band1a 6m
❑	C10	120 pF 5%	121	Ceramic			Band2a 3.5-8 MHz
❑	C10	100 pF 5%	101	Ceramic			Band 2: 4-8 MHz
❑	C11	390 pF 5%	391	Ceramic			Band 2: 4-8 MHz
❑	C11	270 pF 5%	271	Ceramic			Band2a 3.5-8 MHz
❑	C12	120 pF 5%	121	Ceramic			Band2a 3.5-8 MHz
❑	C12	100 pF 5%	101	Ceramic			Band 2: 4-8 MHz

❑	C13	47 pF 5%	47J	Ceramic			Band 3: 8-16 MHz
❑	C14	180 pF 5%	181	Ceramic			Band 3: 8-16 MHz
❑	C15	47 pF 5%	47J	Ceramic			Band 3: 8-16 MHz
❑	C16	27 pF 5%	27J	Ceramic			Band 4: 16-30 MHz
❑	C17	100 pF 5%	101	Ceramic			Band 4: 16-30 MHz
❑	C18	27 pF 5%	27J	Ceramic			Band 4: 16-30 MHz
❑	C19	0.01 uF		SMT 1206			Busses and Rails
❑	JP1	header, 2-pin w/jumper		jumper			Busses and Rails
❑	JP2	header, 2-pin w/jumper		jumper			Busses and Rails
❑	L04	8 uH 49T #30 on T25-2 (22")	red	coil			Band2a 3.5-8 MHz
❑	L05	3.5 uH 32T #30 on T25-2 (15")	red	coil			Band2a 3.5-8 MHz
❑	L06	8 uH 49T #30 on T25-2 (22")	red	coil			Band2a 3.5-8 MHz
❑	L1	23 uH 71T #30 on T30-2 (39")	red	coil			Band 1: 1.8-4 MHz
❑	L1	1.64 uH 23T #30 on T25-6 (15")	yellow	coil			Band1a 6m
❑	L10	2 uH 27T #30 on T25-6 (16")	yellow	coil			Band 4: 16-30 MHz
❑	L10-core	T25-6 toroid core	yellow	toroid			Band 4: 16-30 MHz
❑	L11	0.53 uH 14T #30 on T25-6 (10")	yellow	coil			Band 4: 16-30 MHz
❑	L11-core	T25-6 toroid core	yellow	toroid			Band 4: 16-30 MHz
❑	L12	2 uH 27T #30 on T25-6 (16")	yellow	coil			Band 4: 16-30 MHz

	L12-core	T25-6 toroid core	yellow	toroid			Band 4: 16-30 MHz	
	L1-core	T30-2 toroid core	red	toroid			Band 1: 1.8-4 MHz	1
	L2	10.7 uH 50T #30 on T30-2 (28")	red	coil			Band 1: 1.8-4 MHz	1
	L2	not used		unused			Band1a 6m	
	L2-core	T30-2 toroid core	red	toroid			Band 1: 1.8-4 MHz	1
	L3	23 uH 71T #30 on T30-2 (39")	red	coil			Band 1: 1.8-4 MHz	1
	L3	1.64 uH 23T #30 on T25-6 (15")	yellow	coil			Band1a 6m	
	L3-core	T30-2 toroid core	red	toroid			Band 1: 1.8-4 MHz	1
	L4	8 uH 49T #30 on T25-2 (22")	red	coil			Band 2: 4-8 MHz	2
	L4-core	T25-2 toroid core	red	toroid			Band 2: 4-8 MHz	2
	L5	2.1 uH 24T #30 0n T25-2 (14")	red	coil			Band 2: 4-8 MHz	2
	L5-core	T25-2 toroid core	red	toroid			Band 2: 4-8 MHz	2
	L6	8 uH 49T #30 on T25-2 (22")	red	coil			Band 2: 4-8 MHz	2
	L6-core	T25-2 toroid core	red	toroid			Band 2: 4-8 MHz	2
	L7	4 uH 38T #30 on T25-6 (18")	yellow	coil			Band 3: 8-16 MHz	3
	L7-core	T25-6 toroid core	yellow	toroid			Band 3: 8-16 MHz	3

❑	L8	1.1 uH 20T #30 on T25-6 (11")	yellow	coil			Band 3: 8-16 MHz	3
❑	L8-core	T25-6 toroid core	yellow	toroid			Band 3: 8-16 MHz	
❑	L9	4 uH 38T #30 on T25-6 (18")	yellow	coil			Band 3: 8-16 MHz	3
❑	L9-core	T25-6 toroid core	yellow	toroid			Band 3: 8-16 MHz	
❑	P100	header, 9-pin		header			Busses and Rails	
❑	P101	header, 3-pin		header		Pins: 1=gnd; 2=+5 Vdc; 3=+12Vdc. From V9.0 J2	Busses and Rails	
❑	P102	header,female, 2 pin		socket		2 pin socket provided for later connect to V9.0 RX's J3 (for eventual programmatic band switching, once the microcontroller is reprogrammed)	Bill of Materials	
❑	R01	2.21 k 1/4W 1%	r-r-br-br-br	1/4W	E-W		Busses and Rails	
❑	R02	2.21 k 1/4W 1%	r-r-br-br-br	1/4W	W-E		Busses and Rails	
❑	R03	4.7 k 1/4 W 5%	y-v-r-gl	1/4W	W-E		Busses and Rails	
❑	R04	4.7 k 1/4 W 5%	y-v-r-gl	1/4W	W-E		Busses and Rails	
❑	R05	2.21 k 1/4W 1%	r-r-br-br-br	1/4W	W-E		Busses and Rails	
❑	R06	2.21 k 1/4W 1%	r-r-br-br-br	1/4W	E-W		Busses and Rails	
❑	T1	4T #30 trifilar BN43-2402 (7")		transformer			Transformers	
❑	T1 wire	#30enameled magnetic wire		misc		3 lengths of #30, each 7" (18cm) long,	Transformers	

						should do OK	
❑	T1-core	BN43-2402		binocular core			Transformers
❑	T2	8T/2T bifilar BN43-2402 (10")		transformer			Transformers
❑	T2 wire	#30enameled magnetic wire		misc		primary: one 10" (25 cm) length; secondaries: two 5" (12.5 cm) length should do OK	Transformers
❑	T2-core	BN43-2402		binocular core			Transformers
❑	U1		FST3253 	SOIC-16			Switches
❑	U2		FST3253 	SOIC-16			Switches
❑	wire 1	#30enameled magnetic wire		misc			Band 1: 1.8-4 MHz
❑	wire 2	#30enameled magnetic wire		misc			Band 2: 4-8 MHz
❑	wire 3	#30enameled magnetic wire		misc			Band 3: 8-16 MHz
❑	wire 4	#30enameled magnetic wire		misc			Band 4: 16-30 MHz

HF BPF 08_Band1a 6m

Search: Search selected SDR sites

Band1a 6m Introduction

General

The latest design of the HF-BPF kit now permits of two options:

- Option 1: the original design covering 1.8 MHz - 30 mHz, in 4 bands, and
- Option 2: a board covering 3.5 MHz - 30 MHz plus 6m, in 4 bands

These builders notes describe 4 "bands" and the board layout permits filters for four bands. However, depending upon the option (1 or 2), the bands named "band 1" and "band 2" will be built and installed differently. The changes for Band 1 are as follows (and will be implmented somewhat more elegantly n these note, time and resources permitting):

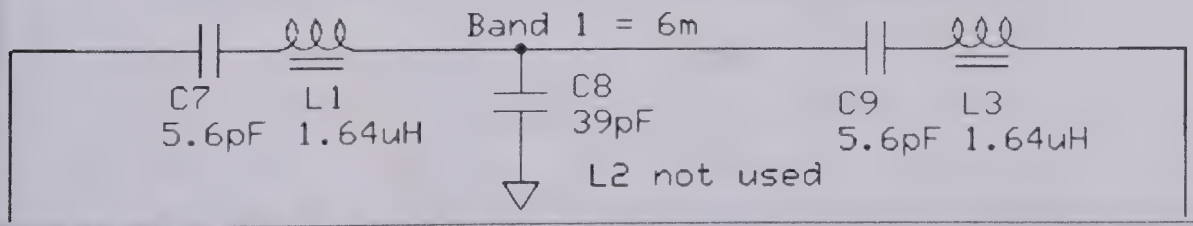
- Band 1 is changed between option 1 (1.8-4 MHz) and option 2 (6m):
  - C7: option 1=150 pF; option 2 = 5.6 pF
  - C8: option 1=330 pF ; option 2 = 39 pF
  - C9: option 1=150 pF ; option 2 = 5.6 pF
  - L1: option 1= 23 uH ; option 2 = 1.64 uH
  - L2: option 1= 10.7uH; option 2 = not used
  - L3: option 1= 23 uH ; option 2 = 1.64 uH

See the

Band1a 6m Schematic

Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in he schematic with red dots)

)



Band1a 6m Bill of Materials

Detailed Bill of Materials

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit

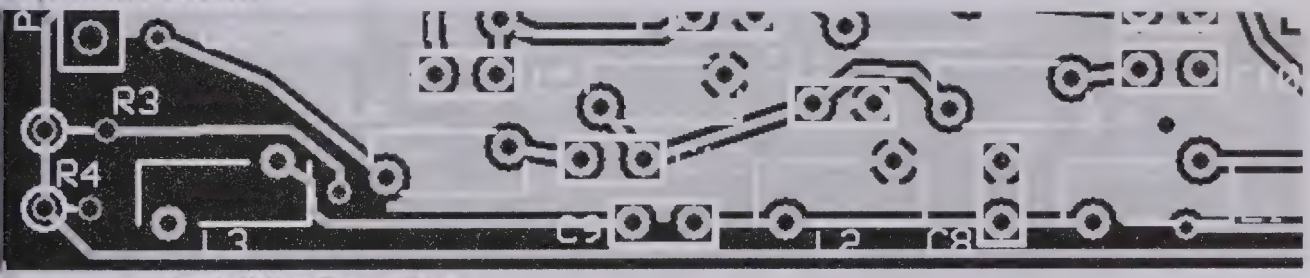
❑	C07	5.6 pF 5%	5.6	Ceramic			Band1a 6m
❑	C08	39pF 5%	39J	Ceramic			Band1a 6m
❑	C09	5.6 pF 5%	5.6	Ceramic			Band1a 6m
❑	L1	1.64 uH 23T #30 on T25-6 (15")		coil			Band1a 6m
❑	L2	unused capacitor		unused			Band1a 6m
❑	L3	1.64 uH 23T #30 on T25-6 (15")		coil			Band1a 6m

Band1a 6m Summary Build Notes

- Install the Capacitors
- Wind and Install the Coils
-

Band1a 6m Detailed Build Notes

Top of the Board



Install the Capacitors

Check	Designation	Component	Marking	Category	Orientation	Notes
❑	C07	5.6 pF 5%	5.6	Ceramic		
❑	C09	5.6 pF 5%	5.6	Ceramic		
❑	C08	39pF 5%	39J	Ceramic		

Wind and Install the Coils

Check	Designation	Component	Marking	Category	Orientation	Notes
❑	L1	1.64 uH 23T #30 on T25-6 (15")		coil		
❑	L3	1.64 uH 23T #30 on T25-6 (15")		coil		
❑	L2	unused capacitor		unused		

Band1a 6m Completed Stage

Top of the Board

View of Completed Top

Band1a 6m Testing

Visual Inspection

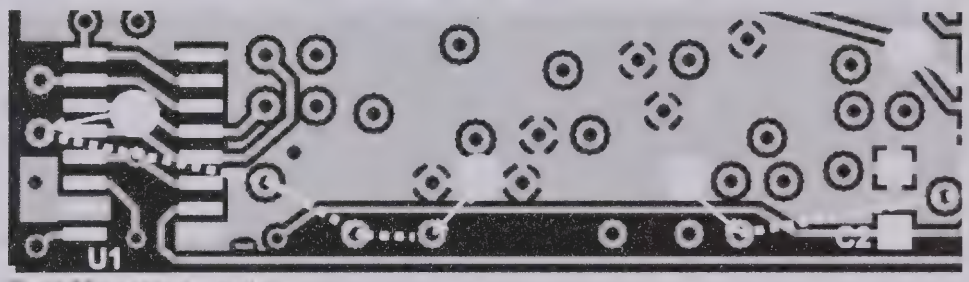
Test Setup

Using very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold joints, or poor contacts.

Pay especial attention to the joints on the inductors. If necessary, touch up the joints with your iron and/or some flux.

Continuity Tests

Test Setup



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Point "A" to poin "A"t	ohms	0	TBD	
Point "A" to poin "A"t	ohms	0	TBD	

HF BPF 02_Switches

Search: Search selected SDR sites

Switches Introduction

General

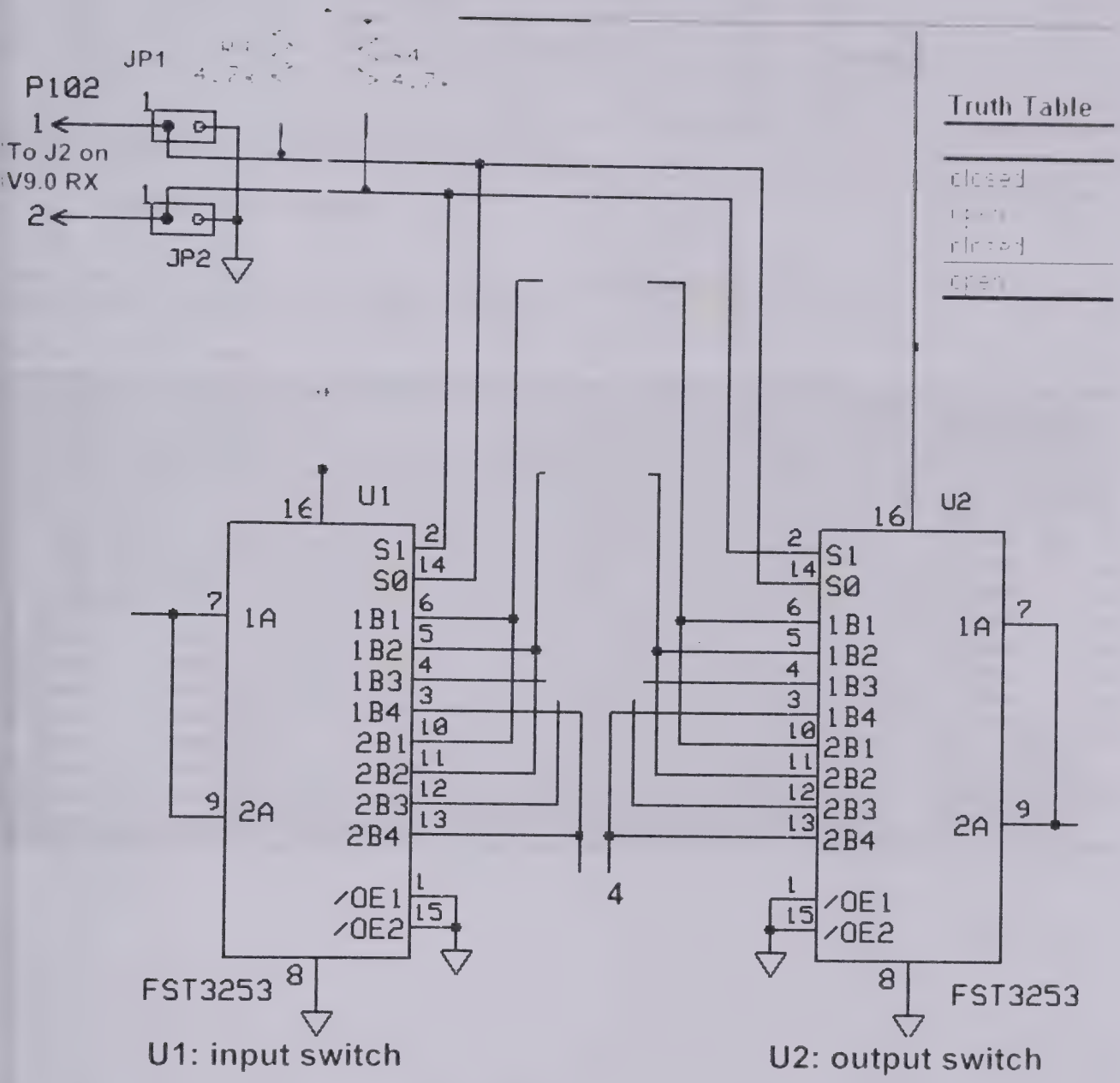
This stage provides the two FST 3253 1-4 switches to permit switching a particular band's filter "chain" nto or out of the board's outputs. The switches essentially "connect" the Input transformer, via a set of ilters, to the output transformer

)

Switches Schematic

Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in he schematic with red dots)

)



)

Switches Bill of Materials

tage Bill of Materials

esistor images and color codes courtesy of 's)

heck	Designation	Component	Marking	Category	Orientation	Notes	Circuit
	U1		FST3253	SOIC-16			Switches

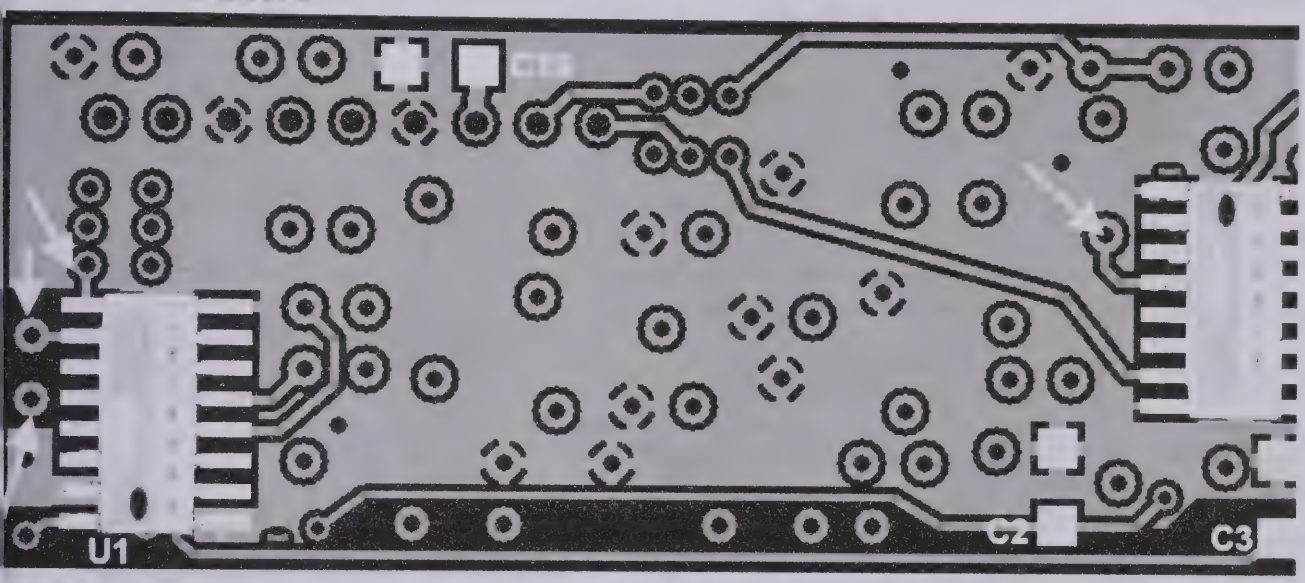
❑	U2		FST3253	SOIC-16			Switches

Switches Summary Build Notes

- Install FST3253 Switches
-

Switches Detailed Build Notes

Bottom of the Board

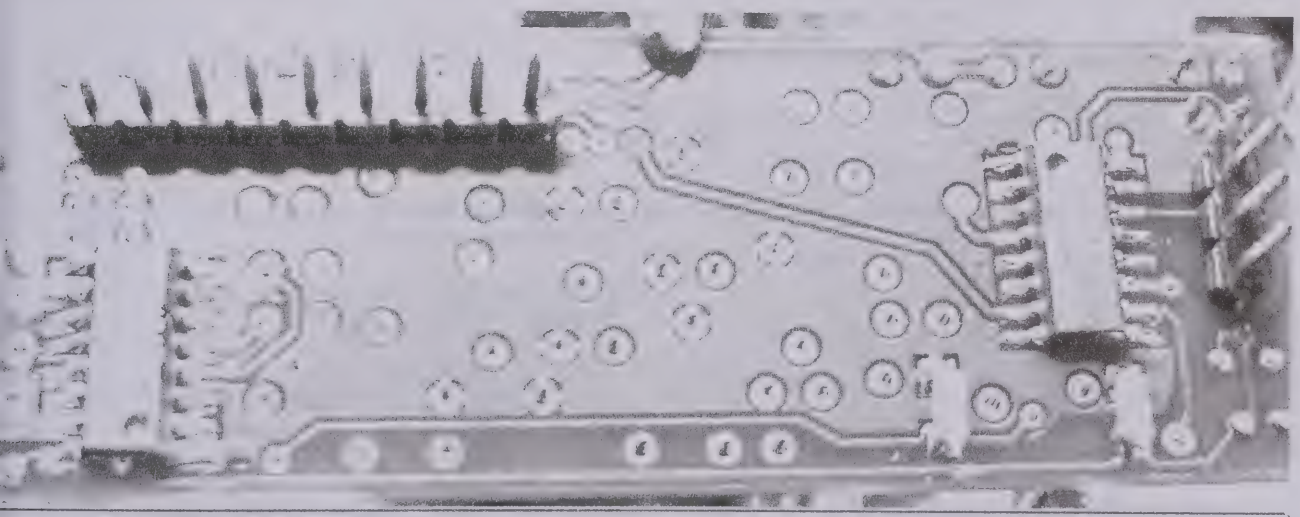


Install FST3253 Switches

Check	Designation	Component	Marking	Category	Orientation	Notes
☐	U1		FST3253	SOIC-16		Take ESD precautio
☐	U2		FST3253	SOIC-16		Take ESD precautio

Switches Completed Stage

Bottom of the Board



Switches Testing

ESD

Test Setup

Take ESD precautions when conducting these inspections and tests. The IC switches are extremely sensitive to static damage.

isual Check

est Setup

sing very good lighting and magnification, carefully inspect the solder joints to identify bridges, cold

oints, or poor contacts.

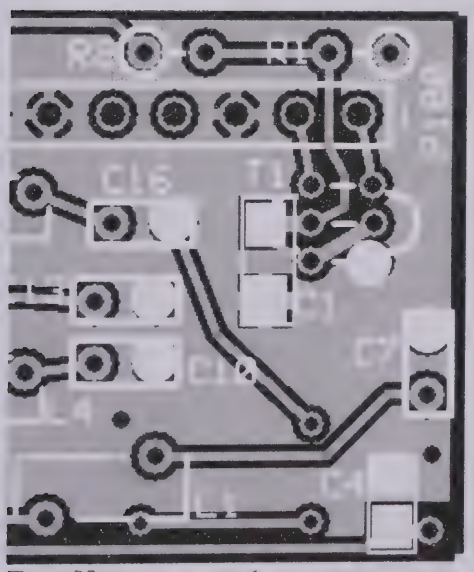
Pay especial attention to the joints on the two IC's pins. If necessary, touch up the joints with your iron and/or some flux. Wick up any excess.

U1 Continuity Tests (only if necessary)

Test Setup

"Continuity" in this case is actually a resistance that is several orders of magnitude below the non-continuity case. Depending upon the ohmmeter, you could see "continuity" indicated by a resistance of between 60 and 90 k ohms; "non-continuity" would be indicated by a resistance of 3 - 6 M ohms.

- The following tests should only be attempted if you have taken good anti-static, ESD precautions, since the potential exists to completely "fry" the FST 3253. This is especially true during the so-called "static season".
- Apply 5 Vdc to the board at P101-2 (+5) and P100-3 (ground)
- For FST 3253 switch U1, measure the continuity between Point X and Points 1, 2, 3, and 4, for each of the appropriate jumper settings on JP1 and JP2
- The terms "open" and "closed" refer to the jumpered status of JP1 and/or JP2. "Open" means not jumpered.
- The nominal result of "X —> 1" means there is continuity between the 2 points. See testpoints graphic below.



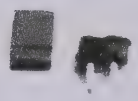
Test Measurements

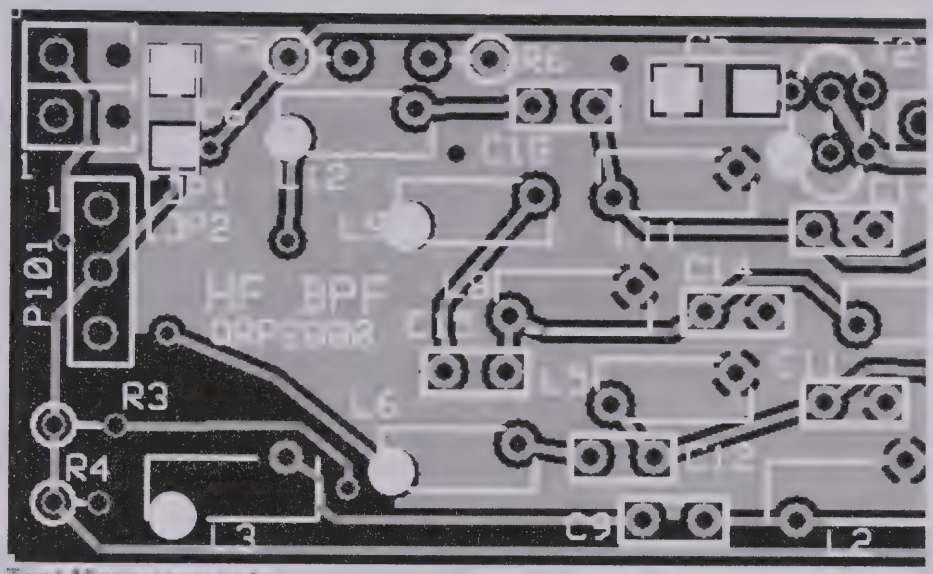
Testpoint	Units	Nominal Value	Author's	Yours
JP1&2 Closed	k ohm	U1: X --->1 (= 70-100)	~64	
JP1 Open, JP2 Closed	k ohm	U1: X --->2 (= 70-100)	~64	
JP1 Closed, JP2 Open	k ohm	U1: X --->3 (= 70-100)	~64	
JP1&2 Open	k ohm	U1: X --->4 (= 70-100)	~64	

U2 Continuity Tests (only if necessary)

Test Setup

"Continuity" in this case is actually a resistance that is several orders of magnitude below the non-continuity case. Depending upon the ohmmeter, you could see "continuity" indicated by a resistance of between 60 and 90 k ohms; "non-continuity" would be indicated by a resistance of 3 - 6 M ohms.

- The following tests should only be attempted if you have taken good anti-static, ESD precautions, since the potential exists to completely "fry" the FST 3253. This is especially true during the so-called "static season".
- Apply 5 Vdc to the board at P101-2 (+5) and P100-3 (ground)
- For FST 3253 switch U2, measure the continuity between Point X and Points 1, 2, 3, and 4, for each of the appropriate jumper settings on JP1 and JP2
- The terms "open" and "closed" refer to the jumpered status of JP1 and/or JP2. "Open" means not jumpered. 
- The nominal result of "X —> 1" means there is continuity between the 2 points. See testpoints graphic below.



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
JP1&2 Closed	k ohm	U2: X --->1 (= 70-100)	~64	
JP1 Open, JP2 Closed	k ohm	U2: X --->2 (= 70-100)	~64	
JP1 Closed, JP2 Open	k ohm	U2: X --->3 (= 70-100)	~64	
JP1&2 Open	k ohm	U2: X --->4 (= 70-100)	~64	

F BPF Project

(new) 11 pgs

(old) ~~before 8/08~~ PDF version

Search selected SDR sites

ct Introduction

s a daughter board, designed by Jan G0BBL and Tony KB9YIG, that provides four electronically l band-pass filters for the Softrock Lite + Xtall V9.0 RX, replacing the single-band daughter board in nal design.

g Information

nd availability of the kit and its options are found at the Softrock Ordering Website.

ions

tronically switched BPF board is 2.5 inches by 0.95 inches. The height will be less than 0.5 inches ting the extension of the connector pins perpendicular to the bottom of the board.

an be built in two different "flavors", each providing four switchable bands:

ion 1: A 160 - 10m version (see main schematic, below), and

ion 2: A 80-10m + 6m version (see inset in lower left corner of schematic below)

vill ship with parts that enable the builder to decide what bands (which "flavor") he/she desires. The self works for both option 1 and option 2. The differences are in the components for the first 2 Caps C07 - C12 and coils L1 - L6.

bility

rd can also be used with the earlier RXTX V6.3 and RX V8.3 kits. However, in those cases, the nust supply the required +5 Vdc bus (and ground connection) to the HF-BPF board, there being no g sockets therefor on the earlier boards.

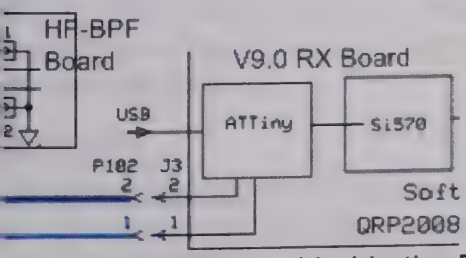
itching

e Rocky as your SDR, the project initially is manually switched, using two header pins and their ed jumpers.

with v9.0 kits shipped after 21 Feb 2009, the USB interface microprocessor will be an ATTiny85 ith JanG0BBL's new enhanced features code. If there is interest in a programmed ATTiny85 device isting v9.0 receiver, contact Tony Parks and he will price the replacement device to cover device yPal loss and mailing cost.

DR and Winrad have enabled the programmatic switching of the board.

ing to V9.0 RX



n socket (P102) provided in the Electronically Switched BPF kit is for use at the end of a kit builder cable to plug onto header J3 on the v9.0 board. The other end of the cable needs to be soldered

PF board at JP1-1 and JP2-1. (The jumper plugs that can be used to test the BPF board are NOT en the BPF selection is from the v9.0 board.) The cable length only needs to be an inch or so and ll gage insulated wire would be suitable.

IA Tests

lins KF4BQ tested (on 13 December 2008) the completed board and the results can be found at

st schematics (1/12/2009) are at the following links:

on 1 - 1.5-30 MHz

on 2 - 3.5-30 MHz plus 6m

of Operation

board gets its power and control signals, as well as inputs and outputs, from the appropriate ts on the Softrock Lite + Xtall RX V9.0

trol signals (two inputs that can each be "high" or "low", resulting in four possible combinations) available at J3 on the V9.0 board and are provided to this board via a cable connection to the holes P102.

er (regulated +5 Vdc) comes from the 3-pin J2 on the V9.0 board via P101

RF antenna inputs and the balanced RF outputs are facilitated via P100, which plugs into the V9.0 rd's 9-pin J1.

n and out are coupled via transformers. T1 couples RF from the antenna into U1, the first of two ching ICs. The second switch, using the same truth table, switches the appropriate bandpass filter uit through to the output transformer, T2, and thence to the pins of P100 that feed the balanced al to the V9.0 RX.

h switch has four outputs, one for each of the four bandpass filters implemented on the board. The ch routes the RF to the appropriate filter, based upon the levels present at S0 and S1 (which can et via JP1 and JP2), according to the following truth table:

)	JP2 (S1)	Band
d	jumpered	1.8=4 MHz
	jumpered	4-8 MHz
d	open	8-16 MHz
	open	16-30 MHz

Vords About The Coils from Jan G0BBL

unts and Inductances

winding data is based on the manufacturer's data used in the toroid calculators that are avaiable. u do NOT have an Inductance meter, then please use these values.

ractice the value of the toroids will be slightly HIGHER than the design value. This has been irmed by a number of amateurs. However as it is much EASIER to take off a turn then to ADD s, I have suggested to Tony and Robby to use the TOROID calculator data instead of the original es which I provided (obtained by measuring coils used in prototype)

o DJ9CS and Mike W1USN checked their winding data and also suggested to use the data from Toroid calculator. Please note that the value of the core AL may vary by +/- 10% as has been tioned elsewhere.

ical Coils

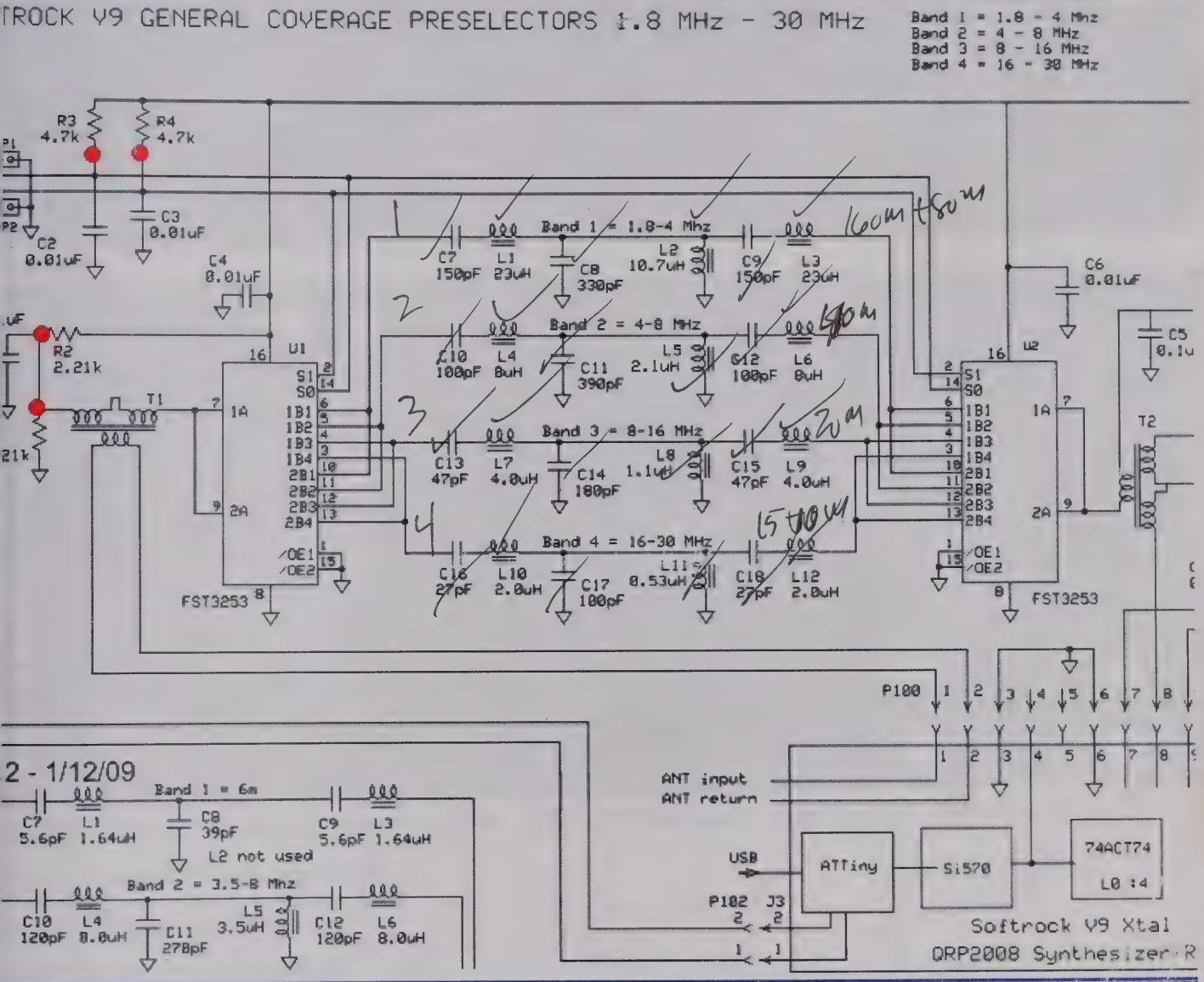
From experience the inductance of the Centre (center, for the colonials) Coil (ie L2. L5,. L8 and L11) is critical for setting the Centre Frequency of the BPF concerned. If you are sure that a BPF is too low in frequency then you may take the effort to take a turn off the centre inductor.

If you have a band which is completely out then closely check the ceramic capacitors. A hairline

crack may indicate the capacitor is faulty. For this reason I would suggest to mount C's about 3mm (1/8") away from the PCB. Capacitors generally will NOT survive desoldering so do not reuse caps.

ct Schematic

testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the c with red dots)



2 - 1/12/09

Band 1 = 6m

C7 5.6pF L1 1.64uH C8 39pF C9 5.6pF L3 1.64uH

L2 not used

Band 2 = 3.5-8 Mhz

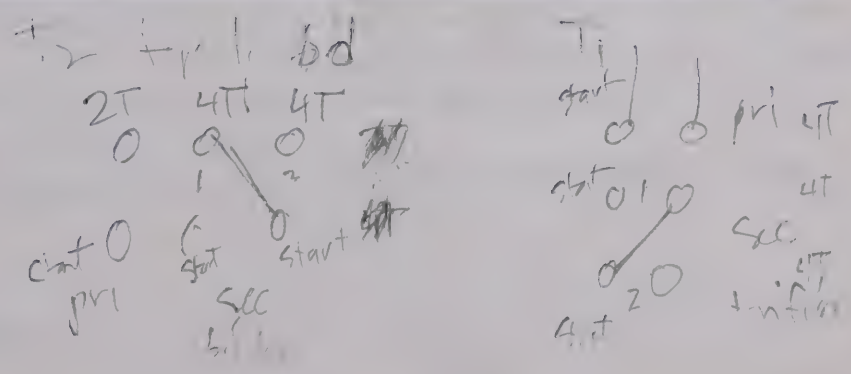
C10 120pF L4 8.0uH C11 270pF L5 3.5uH C12 120pF L6 8.0uH

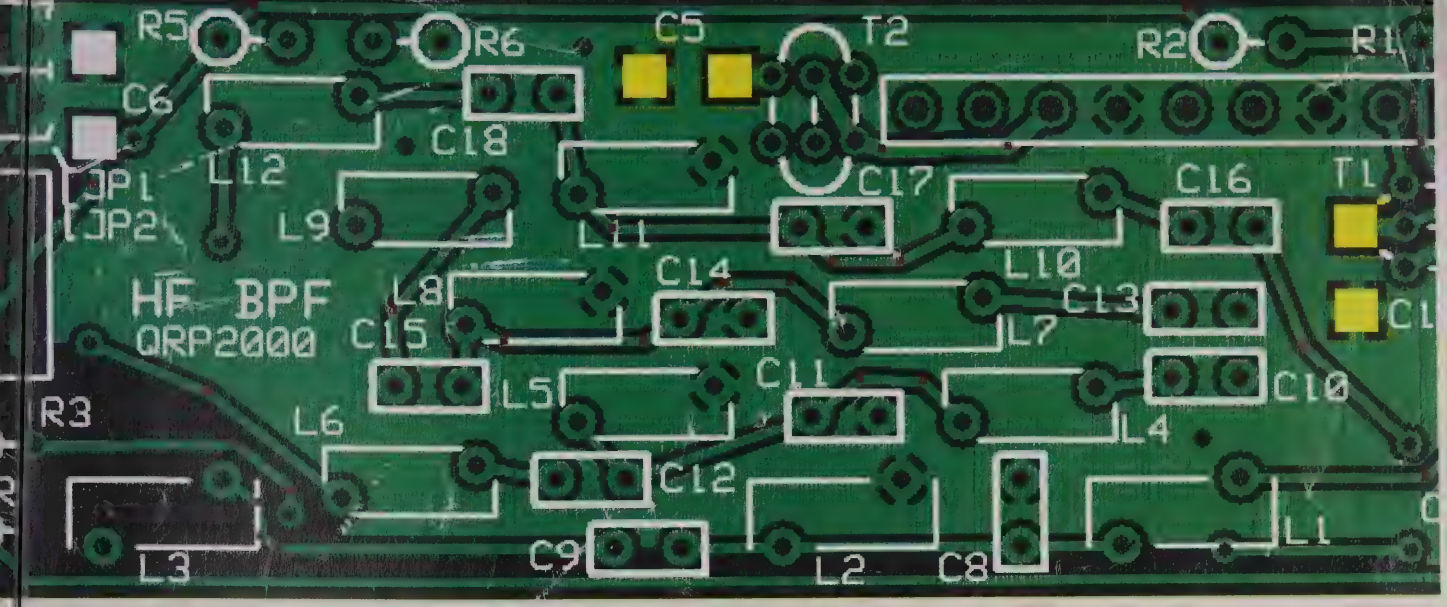
ct Bill of Materials

ect Bill of Materials

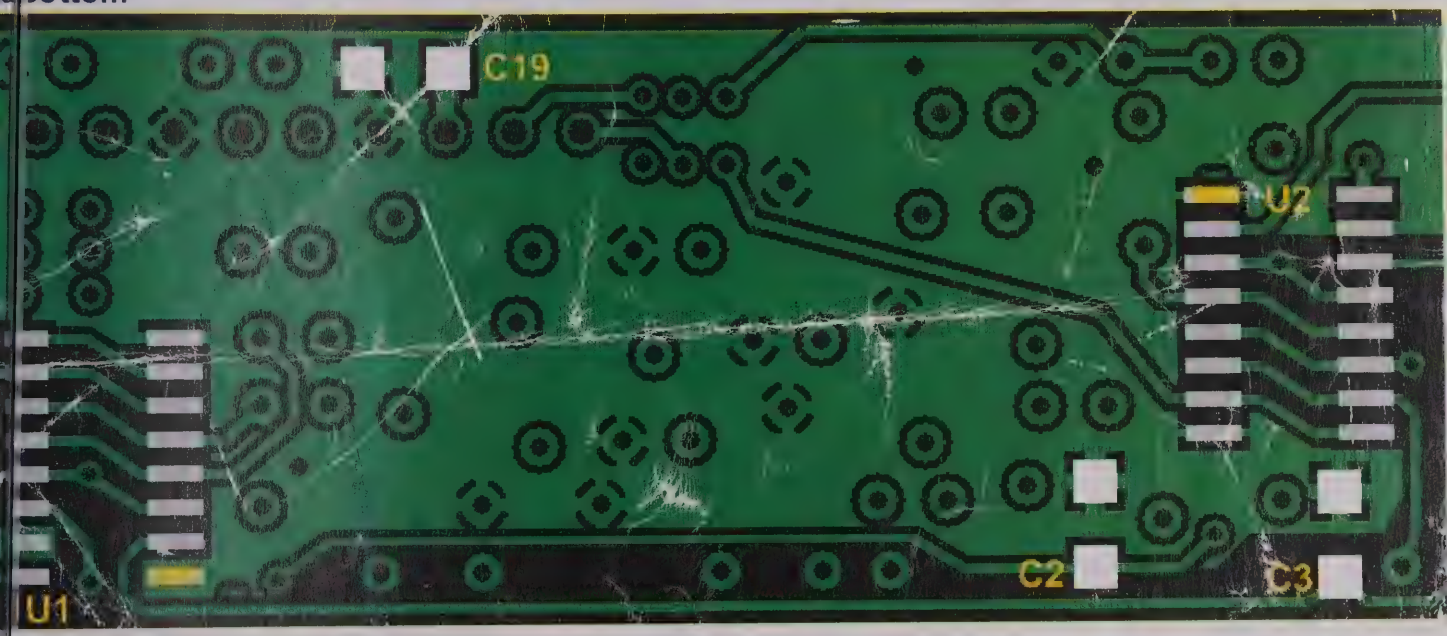
ct Expert's (terse) Build Notes

op





d Bottom



stall all SMT and SOIC components to the bottom of the board, then the top of the board

nd and install the transformers

ind and install the Coils

stall the ceramic capacitors

stall the resistors

stall the jumpers and connectors

SEPW wheelwrse

ect Detailed Build Notes

e non-expert builders among us, this site takes you through a stage-by-stage build of the kit. Each s self-contained and outlines the steps to build and test the stage. This ensures that you will have a better chance of success once you reach the last step, since you will have successfully built and each preceding stage before moving on to the next stage.

stage is listed below, in build order, and you can link to it by clicking on its name below (or in the r and/or footer of each web page).

ventory the Bill of Materials

uild and Test the Busses and Rails Stage

l and Test the Switches Stage

l and Test the Transformers Stage

l and Test the Band 1: 1.8-4 MHz Stage

l and Test the Band 2: 4-8 MHz Stage

l and Test the Band 3: 8-16 MHz Stage

l and Test the Band 4: 16-30 MHz Stage

d and Test the Band1a 6m Stage

d and Test the Band2a 3.5-8 MHz Stage

ground Info

g Inductors

how to wind coils and transformers, please read the

from the experts and then

v the excellent videos on KC0WOXs Website

ake a read of Dinesh's VU2FD guidelines.

u can review the common construction techniques for inductors for details on toroidal and binocular uctors.

ing

eo below describes techniques for soldering SOIC 14 (and 16 and 8) SMDs

ne above in full-screen mode on Youtube.

ead the Primer on SMT Soldering at the Sparkfun site. It is a very good read and it speaks great uths. Then take the time to watch the video tutorial on soldering an SOIC SMD IC.

older Stations. Don't skimp here. Soldering deficiencies account for 80 percent of the problems urfaced in troubleshooting. It is preferable to have an ESD-safe station, with a grounded tip. A couple good stations that are relatively inexpensive are:

Velleman VTSS5U 50W Solder Station (approx $20 at Frys)

Harbor Freight ESD Solder Station (under $50)

ESD Protection

oid carpets in cool, dry areas.

ave PC cards and memory modules in their anti-static packaging until ready to be installed.

sipate static electricity before handling any system components (PC cards, memory modules) by ching a grounded metal object, such as the system unit unpainted metal chassis.

ossible, use antistatic devices, such as wrist straps and antistatic mats (see Radio Shack's Set for 5 or the JameCo AntiStatic mat for $15)).

vays hold a PC card or memory module by its edges. Avoid touching the contacts and components the memory module.

fore removing chips from insulator, put on the wrist strap connected to the ESD mat. All work with MOS chips should be done with the wrist strap on.

an added precaution before first touching a chip, you should touch a finger to a grounded metal rface.

using a DMM, its outside should be in contact with the ground of the ESD mat, and both leads orted to this ground before use.

e the review of ESD Precautions at this link.

Area

ou will need a well-lit work area and a minimum of 3X magnification (the author uses a cheap agnifying fluorescent light with a 3X lens. This is supplemented by a hand-held 10 X loupe - with ht - for close-in inspection of solder joints and SMT installation.

ou should use a cookie sheet or baking pan (with four sides raised approximately a half an inch) for our actual work space. It is highly recommended for building on top of in order to catch stray parts,

the tiny SMT chips which, once they are launched by an errant tweezer squeeze, are nigh ible to find if they are not caught on the cookie sheet.

mportant to solidly clamp the PCB in a holder when soldering. A "third-hand" (e.g., Panavise dricks kits PCB Vise) can hold your board while soldering. In a pinch, you can get by with a d-hand, alligator clip vise. Jan G0BBL suggests "A very cheap way is to screw a Large Clip to a woodblock which will clamp the side of a PCB."

Head Strap

(bent tip is preferable).

and some beeswax - these can be used to pickup SMT devices and hold them steady while

ide cutters.

nded jaw needle-nose pliers.

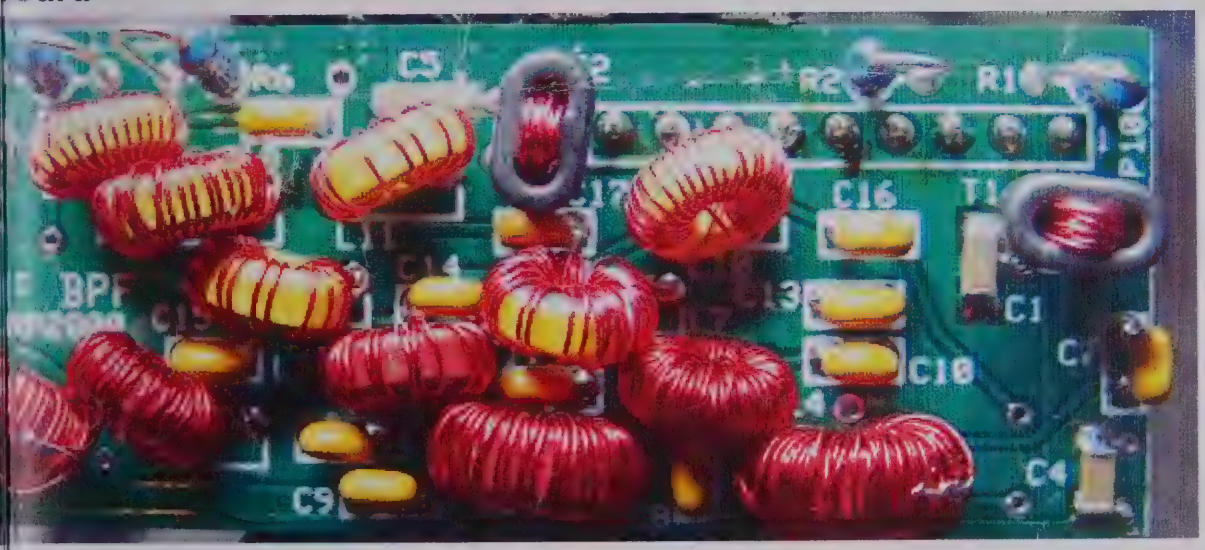
elers' screwdrivers

knife.

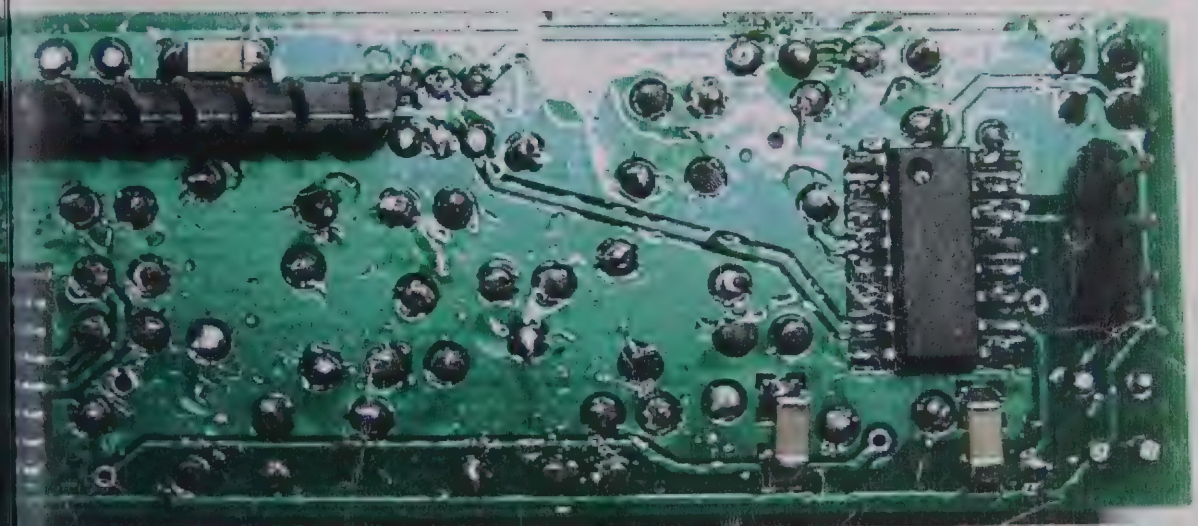
mery paper.

ompleted Stage

oard



e Board



ct Testing

ge will have a "Testing" Section, outlining one or more tests that, when successfully completed, ou with the confidence and assurance that you are heading in the right direction towards a fully d built transceiver.

u perform a test, you should always record the results of the test where indicated in the Testing This will make troubleshooting via the reflector much easier, since you will be communicating with ts using a standard testing and measurement regime.

When comparing measurements to those published in these notes, the builder should be aware that actual and expected values could vary by as much as +/- 10%. The idea behind furnishing "expected/nominal" measurement values is to provide the builder with a good, "ballpark" number to determine whether or not the test has been successful. If the builder has concerns about his measurements, he should by all means pose those concerns as a query in the Softrock reflector so the experts can provide assistance.

It goes without saying that you should ALWAYS precede any tests with a very careful, minute inspection (using the best light and magnification available to you) to be sure all solder joints are clean and there are no solder bridges or cold joints.

This kit can be built and reliably tested using nothing more than a common multimeter. Tests assume that the builder has a decent digital multimeter of sufficiently high input impedance as to minimize circuit loading issues. Measurements will be taken of current draws, test point voltages, and resistances.

Most stages will have a current draw test, in which the builder tests the stage's current draw in two different ways:

- **First, testing the draw through a current-limiting resistor**
- **Then, when that test is OK, removing the current-limiting resistor and measuring the real current draw.**

Some tests will require you to use your ham radio to receive or generate a signal of a specified frequency in order to test transmitters, oscillators, dividers, and/or receivers.

Optional testing. If the builder has (access to) a dual channel oscilloscope, along with an audio signal generator and an RF signal generator, and feels the need to perform tests beyond the basic DMM tests, certain stages will include in their testing section some optional tests involving this advanced equipment.

The IQGen or DQ-Gen programs available free from Michael Keller, DL6IAK, can be used in a pinch to get the sound card to produce audio tones for injection into the circuit.

You can always use Rocky to generate I and Q signals for tests requiring these audio signals (this is the author's preferred way)

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